4.0 ENVIRONMENTAL CONSEQUENCES

This chapter discloses the potential environmental consequences that may result from implementing the Proposed Action or alternatives to the action for the NARO North, NARO South, Little Thunder, West Roundup, and West Antelope LBA[1] Tracts. The alternatives for each tract are described in Chapter 2. The effect or impact a consequence will have on the quality of the human environment is also discussed. For instance, the consequence of an action may be to greatly increase the number of roads in an area. If the number of roads in an area is increased, opportunities for road-based recreation would be increased but the opportunities for primitive recreational activities and solitude would be decreased. Evaluation of the impact would depend on an individual's (or a group's) preferred use of that area.

If an LBA tract is leased to an applicant as a maintenance tract under one of the action alternatives, the permit area for the adjacent mine would have to be amended to include the new lease area before it could be disturbed. Tables 4-1 through 4-4 show the areas to be mined and disturbance areas for the existing applicant mines (which represent the No Action Alternatives), and how the mine areas would change under the action alternatives for each LBA tract. If a tract is leased, the area that would have to be added to the existing mine permit area would be that portion of the LBA tract that lies outside the existing permit boundary plus an adjacent strip of land that would be used for highwall reduction after mining and such mine-related activities as construction of diversions, flood and sediment control structures, roads, and stockpiles. Portions of the LBA tracts that are contiguous to the existing leases will be disturbed under the current mining plans in order to recover the coal in the existing leases. For all five of the LBA tracts included in this analysis, the environmental consequences of implementing either the Proposed Action, Alternative 2, or Alternative 3 would be similar in nature, but in general the action alternative that disturbs the smallest area of land surface would have the least impact. The smallest disturbance area for the NARO North and South LBA Tracts would occur if the Alternative 3 tract configuration for the NARO South LBA Tract is chosen. (Table 4-1). For the Little Thunder and West Roundup LBA Tracts, the Proposed Action tract configuration would have a smaller disturbance area than the other action alternatives (Tables 4-2 and 4-3). For the West Antelope LBA Tract, the Alternative 3 tract configuration would have a smaller disturbance area than the other action alternatives (Table 4-4).

Surface mining and reclamation have been ongoing in the eastern PRB for over two decades. During this time, effective mining and reclamation technologies have been developed and continue to be refined. Mining and reclamation operations are regulated under SMCRA and Wyoming statutes. WDEQ technically reviews all mine permit application packages to ensure

[1] Refer to page xii for a list of abbreviations and acronyms used in this document.

Table 4-1. Comparison of Existing and Proposed North Antelope/Rochelle Complex Disturbance Area and Mining Operations.

	No Action Alternative (Existing Permit Area)	Proposed Action	Alternative 2	Alternative 3
Additional Lease Area (Acres)	---	4,503.02	5,571.19	3,776.27
Total Lease Area (Acres)	14,895.50	19,398.52	20,466.69	18,671.77
Increase in Lease Area (Percent)	---	30.2	37.4	25.4
Estimated Total Disturbance Area (Acres)[1]	20,410	26,000	26,685	25,273
Increase in Estimated Disturbance Area (Percent)	---	27.4	30.7	23.8
Estimated Recoverable Coal Remaining as of 1/02 (Million Tons)[2]	904.4	1,411.3	1,518.3	1,339.3
Increase in Estimated Recoverable Coal as of 1/02 (Percent)	---	56.0	67.9	48.1

Notes:
1 Total Disturbance Area = area to be mined + area disturbed for mine facilities, access roads, haul roads, railroad facilities, stockpiles, etc.
2 Estimated Recoverable Coal Resources = tons of in-place coal × recovery factor.
For the NARO North LBA Tract, in-place coal = 323 million tons (Proposed Action), and PRCC's estimated recovery factor = 95 percent, based on historic operations.
For the NARO South LBA Tract, in-place coal = 241 million tons (Proposed Action), and PRCC's estimated recovery factor = 83 percent, based largely upon unmineable reserves within railroad ROW and unrecoverable coal in partially burned areas.
For the NARO South LBA Tract, in-place coal = 387 million tons (Alternative 2), and PRCC's estimated recovery factor = 79 percent, based largely upon unmineable reserves within railroad ROW and unrecoverable coal in partially burned areas.
For the NARO South LBA Tract, in-place coal = 141.4 million tons (Alternative 3), and PRCC's estimated recovery factor = 91 percent, based largely upon unrecoverable coal in partially burned areas.

that the mining and reclamation plans comply with all state permitting requirements and that the proposed coal mining operations comply with the performance standards of the DOI-approved Wyoming program. BLM and USFS may attach special stipulations to all coal leases (Appendix D), and there are a number of federal and state permit approvals that are required in order to conduct surface mining operations (Appendix A). The regulations are designed to ensure that surface coal mining impacts are mitigated. The impact assessment that follows considers all measures required by federal and state regulatory authorities as part of the Proposed Action and Alternatives. Section 4.1 analyzes the direct and indirect impacts that would be associated with mining the five LBA tracts included in this analysis if they are leased under the respective Proposed Actions and alternative tract configurations. Section 4.2 presents the probable environmental consequences of the No Action Alternatives (Alternative 1, not issuing leases for one or more of the

Table 4-2. Comparison of Existing and Proposed Black Thunder Mine Disturbance Area and Mining Operations.

	No Action Alternative (Existing Permit Area)	Proposed Action	Alternative 2	Alternative 3	
				North Tract	South Tract
Additional Lease Area (Acres)	---	3,449.32	5,083.50	1,065.49	4,018.01
Total Lease Area (Acres)	12,772.90	16,222.22	17,856.40	17,856.40	
Increase in Lease Area (Percent)	---	27.0	39.8	39.8	
Estimated Total Disturbance Area (Acres)[1]	18,476	23,900	25,053	25,053	
Increase in Estimated Disturbance Area (Percent)	---	29.4	35.6	35.6	
Estimated Recoverable Coal as of 1/02 (Million Tons)[2]	920.3	1,361.3	1,473.1	1,473.1	
Increase in Estimated Recoverable coal as of 1/02 (Percent)	---	48	60	60	

Notes: [1] Total Disturbance Area = area to be mined + area disturbed for mine facilities, access roads, haul roads, railroad facilities, stockpiles, etc.

[2] Estimated Recoverable Coal Resources = tons of in-place coal × recovery factor.
For the Little Thunder LBA Tract, in-place coal = 479.3 million tons (Proposed Action), and TBCC's estimated recovery factor = 92 percent, based on unmineable reserves within railroad ROW.
For the Little Thunder LBA Tract, in-place coal = 695.3 million tons (Alternative 2), and TBCC's estimated recovery factor = 79.5 percent based primarily on unmineable reserves within railroad ROW.
For the Little Thunder LBA Tract, in-place coal = 155.7 million tons (Alternative 3, North Tract), and TBCC's estimated recovery factor = 71.9 percent based primarily on unmineable reserves within railroad ROW.
For the Little Thunder LBA Tract, in-place coal = 539.6 million tons (Alternative 3, South Tract), and TBCC's estimated recovery factor = 81.7 percent based primarily on unmineable reserves within railroad ROW.

Table 4-3. Comparison of Existing and Proposed North Rochelle Mine Disturbance Area and Mining Operations.

	No Action Alternative (Existing Permit Area)	Proposed Action	Alternative 2	Alternative 2 Plus Lease WY-127221 Modification	Alternative 3	Alternative 3 Plus Lease WY-127221 Modification
Additional Lease Area (Acres)	---	1,870.65	2,496.79	2,652.69	2,894.03	3,049.93
Total Lease Area (Acres)	3,443.5	5,314.15	5,940.29	6,096.19	6,337.53	6,493.43
Increase in Lease Area (Percent)	---	54.3	72.5	77.0	84.0	88.6
Estimated Total Disturbance Area (Acres)[1]	5,288	8,449	8,449	8,449	8,879	8,879
Increase in Estimated Disturbance Area (Percent)	---	59.8	59.8	59.8	67.9	67.9
Estimated Recoverable Coal as of 1/02 (Million Tons)[2]	255	410.9	457.1	468.8	501.8	513.5
Increase in Estimated Recoverable Coal as of 1/02 (Percent)	---	61	79	84	97	101

Notes: [1] Total Disturbance Area = area to be mined + area disturbed for mine facilities, access roads, haul roads, railroad facilities, stockpiles, etc.
[2] Estimated Recoverable Coal Resources = tons of in-place coal × recovery factor.
For the West Roundup LBA Tract, in-place coal = 173.2 million tons (Proposed Action), 224.6 million tons (Alternative 2), 237.6 million tons (Alternative 2 plus Lease WYW-127221 Modification), 274.2 million tons (Alternative 3) or 287.2 million tons (Alternative 3 plus Lease WYW-127221 Modification) and TCC's estimated recovery factor = 90 percent, based on historic operations.

Table 4-4. Comparison of Existing and Proposed Antelope Mine Disturbance Area and Mining Operations.

	No Action Alternative (Existing Permit Area)	Proposed Action	Alternative 2	Alternative 3
Additional Lease Area (Acres)	---	3,542.19	3,877.90	2,809.13
Total Lease Area (Acres)	8,019.20	11,561.39	11,897.10	10,828.33
Increase in Lease Area (Percent)	---	44.2	48.4	35.0
Estimated Total Disturbance Area (Acres)[1]	8,821	12,021	12,321	11,288
Increase in Estimated Disturbance Area (Percent)	---	36.3	39.7	28.0
Estimated Recoverable Coal Remaining as of 1/02 (Million Tons)[2]	347.3	575.7	601.6	517.7
Increase in Estimated Recoverable Coal as of 1/02 (Percent)	---	66	73	49

Notes: [1] Total Disturbance Area = are to be mined + area disturbed for mine facilities, access roads, haul roads, railroad facilities, stockpiles, etc.
[2] Estimated Recoverable Coal Resources = tons of mineable coal × recovery factor.
For the West Antelope LBA Tract, in-place coal = 293.9 million tons, mineable coal 245.6 million tons (Proposed Action). For the West Antelope LBA Tract, in-place coal = 321.8 million tons, mineable coal = 273.4 million tons (Alternative 2). For the West Antelope LBA Tract, in-place coal = 202.3 million tons, mineable coal = 183.2 million tons (Alternative 3). ACC's estimated recovery factor = 93 percent after eliminating coal that won't be mined beneath Antelope Creek valley.

tracts). Section 4.3 discusses regulatory compliance, mitigation, and monitoring in terms of what is required by federal and/or state law (and is therefore part of the Proposed Actions and Alternatives) and any additional mitigation and monitoring that may be required. Section 4.4 summarizes the residual effects of the Proposed Actions, and Alternatives. Section 4.5 discusses the cumulative impacts that would occur if all these lands were mined when added to other past, present, and reasonably foreseeable future actions. The cumulative impact analysis includes a discussion of other projects that are in progress, or are proposed in Campbell and Converse Counties, Wyoming, and that would occur independently of leasing the LBA tracts. Projects that have proceeded beyond preliminary planning phases include: 1) construction and operation of the Two Elk power plant, which has been proposed near the Black Thunder Mine; 2) construction and operation of the Wygen #1 power plant, of which construction has began at the Wyodak Mine site; 3) the construction and operation of the DM&E Railroad line; and 4) the ongoing development of CBM resources adjacent to and west of the area of active mining. Projects that are in preliminary planning stages include: 1) construction and operation of the Two Elk Unit Two Power Plant, also proposed adjacent to the Black Thunder Mine; 2) construction and operation of the Middle Bear Power Plant, proposed to be located east of the Cordero-Rojo Complex; 3) construction and operation of the Wygen #2 power plant which has been proposed near the Wygen #1 power plant at the Wyodak Mine site; and 4) construction of a power transmission line from the Two Elk power plants. Section 4.6 analyzes the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity. Section 4.7 presents the irreversible and irretrievable commitments of resources that would occur with implementation of the Proposed Actions or action alternatives.

4.1 Direct and Indirect Impacts of Action Alternatives

Impacts can range from beneficial to adverse and they can be a primary result of an action (direct) or a secondary result (indirect). They can be permanent, long-term (persisting beyond the end of mine life and reclamation), or short-term (persisting during mining and reclamation and through the time the reclamation bond is released). Impacts also vary in terms of significance. The basis for conclusions regarding significance are the criteria set forth by the Council on Environmental Quality (40 CFR 1508.27) and the professional judgement of the specialists doing the analyses. Impact significance may range from negligible to substantial; impacts can be significant during mining but be reduced to insignificance following completion of reclamation.

4.1.1 Topography and Physiography

Surface coal mining would permanently alter the topography of each LBA tract that is leased and mined. Topsoil would be removed from the land and stockpiled or

placed directly on recontoured areas. Overburden would be blasted and stockpiled or directly placed into the already mined pit, and coal would be removed. The existing topography on each LBA tract would be substantially changed during mining. Highwalls with vertical heights equal to overburden, interburden, and coal thicknesses would exist in the active pits. If necessary, streams would be diverted into temporary channels or blocked to prevent flooding of the pits.

Typically, a direct permanent impact of coal mining and reclamation is topographic moderation. After reclamation, the restored land surfaces are generally gentler, with more uniform slopes and restored basic drainage networks. The original topography in the NARO North, Little Thunder, West Roundup and West Antelope tracts is relatively flat, with average slopes ranging from one to three percent. As a result, the expected postmining topography on these tracts would be similar to the premining topography. On the NARO South LBA Tract, slopes average about five percent. Since the NARO South LBA Tract is characterized by steeper slopes, the post-mining topography on this tract would be gentler and more uniform than the pre-mining topography. Following reclamation, the average surface elevation on each LBA tract would be lower due to coal removal. The removal of the coal would be partially offset by the swelling that occurs when the overburden and interburden are blasted and removed. Table 4-5 presents the approximate postmining surface elevation change for each LBA tract as applied for under the Proposed Action and action alternatives. After the coal is removed, the land surface would be restored to approximate original contour or to a configuration approved by WDEQ/LQD when the mining and reclamation permit for the existing mine is revised to include the LBA tract.

Direct adverse impacts resulting from topographic moderation include a reduction in microhabitats (e.g., cutbank slopes) for some wildlife species and a reduction in habitat diversity, particularly a reduction in slope-dependent shrub communities and associated habitat. These impacts would be greater on the tracts characterized by steeper pre-mining topography. A potential indirect impact may be a long-term reduction in big game carrying capacity. A direct beneficial impact of the lower and flatter terrain would be reduced water runoff, which would allow increased infiltration and result in a minor reduction in peak flows. This may help counteract the potential for increased erosion that could occur as a result of higher near-surface bulk density of the reclaimed soils (Section 4.1.3). It may also increase vegetative productivity, and potentially accelerate recharge of groundwater.

For each LBA tract, the approximate original drainage pattern would be restored, and stock ponds and playas would be replaced to provide livestock and wildlife watering sources. These topographic changes would not conflict with regional land use, and the postmining topography would be designed to adequately support anticipated land use.

Table 4-5. Average Overburden, Interburden, and Coal Thicknesses and Approximate Postmining Surface Elevation Changes of the Five LBA Tracts.

LBA Tract and Configuration	Overburden Thickness (ft)	Interburden Thickness (ft)	Coal Thickness (ft)	Swell Factor (percent)	Coal Recovery Factor (percent)	Postmining Elevation Change[1]
NARO North						
Proposed Action	307	0	79	15	95	29 ft lower
NARO South						
Proposed Action	113	61	69	12	95	45 ft lower
Alternative 2	145	60	70	12	95	42 ft lower
Alternative 3	99	63	67	12	95	44 ft lower
Little Thunder						
Proposed Action	260	54	97	16	92	39 ft lower
Alternative 2	279	46	98	16	92	38 ft lower
Alternative 3 (North Tact)	310	18	96	16	92	36 ft lower
Alternative 3 (South Tract)	269	58	98	16	92	38 ft lower
West Roundup						
Proposed Action	318	0	69	16	90	11 ft lower
Alternative 2	306	0	67	16	90	11 ft lower
Alternative 3	316	0	67	16	90	10 ft lower
Lease WYW-127221 Modification	233	0	57	16	90	14 ft lower
West Antelope						
Proposed Action	138	68	88	22	93	37 ft lower
Alternative 2	150	67	89	22	93	35 ft lower
Alternative 3	140	62	81	22	93	31 ft lower

Notes: [1] Reclaimed (postmining) elevation change calculated as: (coal thickness × coal recovery factor) - swell factor × (overburden thickness + interburden thickness).

These impacts are occurring on the existing North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mine coal leases as coal is mined and mined-out areas are reclaimed. Under the Proposed Action, Alternative 2, or Alternative 3, the areas that would be permanently topographically changed would increase as shown in Tables 4-1 through 4-4.

4.1.2 Geology

The geology from the base of the lowest coal seam mined to the land surface would be subject to permanent change after the coal is removed on the LBA tracts under the Proposed Actions and action alternatives. The subsurface characteristics of these lands would be radically changed by mining. The replaced overburden and interburden (backfill) would be a mixture of the geologically distinct layers of sandstone, siltstone, and shale that currently exist. The resulting physical characteristics would also be significantly altered.

Drilling and sampling programs are conducted on the existing leases by all mine operators to identify overburden material that may be unsuitable for reclamation (i.e.,material that is not suitable for use in reestablishing vegetation or that may affect groundwater quality due to high concentrations of certain constituents such as selenium or adverse pH levels). As part of the mine permitting process, each mine operator develops a management plan to ensure that this unsuitable material is not placed in areas where it may affect groundwater quality or revegetation success. Each mine operator also develops backfill monitoring plans as part of the mine permitting process to evaluate the quality of the replaced overburden. These plans are in place for the existing North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mines and would be developed for the LBA tracts if they are leased.

NARO North and South LBA Tracts

Within the NARO North LBA Tract, mining would remove an average of 307 ft of overburden, no interburden, and 79 ft of coal on about 2,369 acres under the Proposed Action. Within the NARO South LBA Tract under the Proposed Action and Alternatives 2 and 3, the coal reserves beneath an area of approximately 578 acres were burned by spontaneous coal fires in the past. Under the Proposed Action for the NARO South LBA Tract, mining would remove an average of 113 ft of overburden, 61 ft of interburden, and 69 ft of coal on about 1,556 acres. Under Alternative 2, mining would remove an average of 145 ft of overburden, 60 ft of interburden, and 70 ft of coal on about 2,624 acres from the NARO South LBA Tract. Under Alternative 3, mining would remove an average of 99 ft of overburden, 63 ft of interburden, and 67 ft of coal on about 829 acres from the NARO South LBA Tract. Some of the coal that is included in the NARO South LBA Tract under the Proposed Action or Alternative 2 is located within the BNSF & UP railroad ROW and would, therefore, not be mined because it has been determined to be unsuitable for mining according to the coal

leasing unsuitability criteria (43 CFR 3461). Table 4-5 presents the average overburden, interburden, and coal thicknesses for the NARO North and South LBA Tracts as applied for and Alternatives 2 and 3. Table 4-6 presents the average overburden, interburden and mineable coal thicknesses for the existing North Antelope/Rochelle Complex permit area.

The replaced overburden and interburden would be a relatively homogeneous (compared to the premining layered overburden and interburden) and partly recompacted mixture averaging about 357 ft in thickness in the NARO North LBA Tract under the Proposed Action. The backfill in the NARO South LBA Tract would average about 198 ft in thickness under the Proposed Action, about 233 ft in thickness under Alternative 2, and about 185 ft in thickness under Alternative 3. A total of approximately 506.9 million additional tons of coal would be recovered from both tracts under the Proposed Action, compared to an estimated 613.9 million tons under Alternative 2, or an estimated 434.9 million tons under Alternative 3.

Little Thunder LBA Tract

Within the Little Thunder LBA Tract, there is an average of 260 ft of overburden, 54 ft of interburden, and 97 ft of coal on about 3,449 acres under the Proposed Action. There is an average of 279 ft of overburden, 46 ft of interburden, and 98 ft of coal on about 5,084 acres included in the Little Thunder LBA Tract Alternative 2 tract configuration. Under Alternative 3 for the Little Thunder LBA Tract, there is an average of 310 ft of overburden, 18 ft of interburden, and 96 ft of coal on about 1,065 acres included in the north tract, and an average of 269 ft of overburden, 58 ft of interburden, and 98 ft of coal on about 4,018 acres included in the south tract. Some of the coal that is included in the Little Thunder LBA Tract under the Proposed Action or Alternatives 2 or 3 is located within the BNSF & UP railroad or Wyoming Highway 450 ROWs and would, therefore, not be mined because it has been determined to be unsuitable

Table 4-6. Average Overburden, Interburden, and Coal Thicknesses for the Applicant Mines' Existing Permit Areas.

Applicant Mine	Average Overburden Thickness (ft)	Average Interburden Thickness (ft)	Average Total Mineable Coal Thickness (ft)
North Antelope/Rochelle Complex	205	0	67
Black Thunder	204	11	74
North Rochelle	210	0	60
Antelope	135	62	86

for mining according to the coal leasing unsuitability criteria (43 CFR 3461). Therefore, the area of coal removal under the Proposed Action and Alternatives 2 and 3 would actually be somewhat smaller than the acreages shown above. Table 4-5 presents the average overburden, interburden and coal thicknesses for the Little Thunder LBA Tract as applied for and Alternatives 2 and 3. Table 4-6 presents the average overburden, interburden and mineable coal thicknesses for the existing Black Thunder Mine permit area.

The replaced overburden and interburden would be a relatively homogeneous (compared to the premining layered overburden and interburden) and partly recompacted mixture averaging about 372 ft in thickness under the Proposed Action, and about 385 ft in thickness under Alternative 2. Under Alternative 3, the replaced overburden would average about 388 ft in thickness in the North tract and about 387 ft in thickness in the South tract. Approximately 440 million additional tons of coal would be recovered under the Proposed Action, compared to 553 million tons under Alternatives 2 and 3 (111.9 million tons in the North tract and 441.1 million tons in the South tract).

West Roundup LBA Tract

Within the West Roundup LBA Tract, mining would remove an average of 318 ft of overburden, no interburden, and 69 ft of coal on about 1,871 acres under the Proposed Action. Mining would remove an average of 306 ft of overburden, no interburden, and 67 ft of coal on about 2,497 acres under the Alternative 2 tract configuration. Mining would remove an average of 316 ft of overburden, no interburden, and 67 ft of coal on about 2,894 acres under the Alternative 3 tract configuration. Mining would also remove an average of 233 ft of overburden, no interburden, and 57 ft of coal on about 156 acres of additional lands that would be included in the LBA Tract if federal coal lease WYW-127221 is not modified as is currently proposed. These acreage figures represent the estimated area of actual coal removal under the Proposed Action, Alternatives 2 and 3, and the proposed lease WYW-127221 modification area. Table 4-5 presents the average overburden, interburden and coal thicknesses for the West Roundup LBA Tract as applied for, Alternatives 2 and 3, and lease WYW-127221 modification area. Table 4-6 presents the average overburden, interburden and coal thicknesses for the existing North Rochelle Mine permit area.

The replaced overburden and interburden would be a relatively homogeneous (compared to the premining layered overburden and interburden) and partly recompacted mixture averaging about 376 ft in thickness under the Proposed Action, about 362 ft in thickness under Alternative 2, about 373 ft in thickness under Alternative 3, and about 276 ft in thickness on the lease WYW-127221 modification area. Approximately 155.9 million additional tons of coal would be recovered under the Proposed Action, compared to 202.1 million tons under Alternative 2, 246.8 million tons

under Alternative 3, and 11.7 million tons from the lease WYW-127221 modification area.

West Antelope LBA Tract

Within the West Antelope LBA Tract, mining would remove an average of 138 ft of overburden, 68 ft of interburden, and 88 ft of coal on about 2,755 acres under the Proposed Action. Mining would remove an average of 150 ft of overburden, 67 ft of interburden, and 89 ft of coal on about 3,091 acres under the Alternative 2 tract configuration. Mining would remove an average of 140 ft of overburden, 62 ft of interburden, and 81 ft of coal on about 2,022 acres under the Alternative 3 tract configuration. These acreage figures represent the estimated area of actual coal removal under the Proposed Action and Alternatives 2 and 3. Table 4-5 presents the average overburden, interburden and coal thicknesses for the West Antelope LBA Tract as applied for and Alternatives 2 and 3. Table 4-6 presents the average overburden, interburden and coal thicknesses for the existing Antelope Mine permit area.

The replaced overburden and interburden would be a relatively homogeneous (compared to the premining layered overburden and interburden) and partly recompacted mixture averaging about 257 ft in thickness under the Proposed Action, about 271 ft in thickness under Alternative 2, and about 252 ft in thickness under Alternative 3. Approximately 228.4 million additional tons of coal would be recovered under the Proposed Action, compared to 254.3 million tons under Alternative 2 and 170.4 million tons under Alternative 3.

4.1.2.1 Mineral Resources

During mining, other minerals present on each of the LBA tracts could not be developed. Some of these minerals could, however, be developed after mining. Conventional oil and gas wells would have to be plugged during mining, but could be re-completed after mining if the remaining reserves economically justify the expense of the re-completion. All oil and gas production equipment would have to be removed to a level below the coal. The reservoir which these wells produce from would not be disturbed by removal of the coal. The oil and gas lessee could re-complete or re-drill wells to recover remaining oil and gas resources from any subcoal oil and gas reservoirs following mining. This would only occur if they believe that the value of the remaining reserves would justify the expense of reestablishing production. Section 3.3 includes a discussion on the oil and gas fields in the General Analysis Area and the LBA tracts that overlie them, as well as discussions on the currently producing wells and their associated facilities specific to each of the LBA tracts and associated action alternatives.

CBM resources that are not recovered prior to mining would be irretrievably lost when the coal is removed. As discussed in Sections 3.3 and 3.11, CBM wells are being drilled on and/or near each of the LBA tracts in the General Analysis Area. The Little Thunder LBA Tract is currently the

only LBA tract with producing CBM wells within the General Analysis Area. The NARO North, West Roundup and West Antelope LBA Tracts include CBM wells in various stages of development (e.g., permitting, drilling, etc.) which were not producing when this document was prepared. Since there is a very limited production history from wells within the General Analysis Area, there is limited data available to estimate well life for existing or future CBM wells.

For the purposes of this draft EIS, the BLM WSO-RMG reviewed the existing CBM resource and production data in the General Analysis Area. All productive CBM wells within the ten-township area which covers the General Analysis Area were reviewed to determine whether decline curve analysis could be used to forecast reserves or evaluate well economics. None of the wells had sufficient production to yield decline curves that could be accepted with confidence for forecasting purposes. These analyses did indicate that CBM reserves are probably limited in the General Analysis Area, suggesting that shorter well lives might be expected. Provisional decline curves which were prepared for several wells with the lengthiest production histories suggest that well life periods for wells located on or near the LBA lands might be on the order of one to five years.

Since none of the wells in the General Analysis Area had sufficient production histories to yield decline curves that could be accepted with confidence for forecasting purposes, WSO-RMG evaluated CBM resources/reserves using volumetric methods: the estimated gas-in-place (in scf/ton) within each proposed LBA tract was multiplied by the reported number of tons of coal within the subject tract to obtain an in-place resource volume.

Detailed CBM resource analyses have been prepared by the WSO-RMG in support of coal leasing actions and other program activities in the General Analysis Area and at other localities in the PRB mining area. Coal seam gas-in-place is dependent on a number of factors, including coal rank, coal lithology, and particularly for the purposes of these analyses, methane adsorptive capacity of the coals, which is controlled by hydrostatic pressure within the coal seam. Methane adsorption analyses describe the volume of methane that can be adsorbed by a specific sample of coal across a varying range. This pressure/volume relationship can be represented by an equation and curve known as an adsorption isotherm. Although gas content can vary widely from sample to sample depending upon other properties of the coal, the adsorption data provide a means of predicting coal bed methane adsorptive capacity based on pressure.

WSO-RMG has developed preliminary CBM reservoir models based on these principles to estimate CBM gas content and in-place resources in the mining areas and elsewhere in the PRB. These analyses use publicly available methane adsorption data collected cooperatively by the WSO-RMG and the U.S. Geological Survey, coal geology from publicly-available coal drill holes, and hydrologic data

from groundwater monitoring wells that are reported by GAGMO. This model can be used to calculate and map hydrostatic pressure within the coal seams based on the annual reported water levels. The data and model were used to calculate and map an estimated coal gas content (in scf/ton) across the General Analysis Area in 1982, prior to extensive mining, and subsequently in 2000 (the latest year for which data are available). An average gas content for each proposed LBA tract can be estimated from the maps (year 2000) of estimated gas content. An evaluation of CBM gas-in-place was prepared using the coal reserves (in tons) reported in each LBA application and the estimated coal gas content (in scf/ton) for each LBA tract as visually estimated from the 2000 gas content map. The results of this evaluation are shown in the following tract discussions.

Implicit in the analysis conducted by WSO-RMG is the observation that coal mining and mine-related dewatering affects CBM resources and development potential. As described, water production from the coal seams is required to reduce hydrostatic pressure in the coal seams so that methane can desorb from the coals for production. Mine-related dewatering of the coal seams has the same effect of reducing hydrostatic pressure and methane desorption. The preliminary CBM reservoir models indicate that depletion of the hydrostatic pressures and methane resources has occurred adjacent to mining areas since not long after mining began. Based on the methane adsorption/pressure analyses, the preliminary model shows that as much as 60 percent of the original in-place CBM resources in the LBA areas may have been depleted since 1982. This effect will be enhanced as mining proceeds toward the LBA tracts and will continue whether or not they are leased and mined. The short productive life inferred for CBM wells in the LBA areas suggests that wells which are completed early could recover substantial portions of the remaining reserves prior to any mining within the LBA tracts.

NARO North and South LBA Tracts

CBM is not currently being produced on the NARO North and NARO South LBA Tracts as proposed or on lands added under Alternative 2. Under the Proposed Action, there would potentially be 29 and 26 CBM well locations on the NARO North and NARO South LBA Tracts, respectively, if all the 80-acre spacing units within the tract were drilled. There would be 13 more potential CBM well sites on lands added by Alternative 2, while Alternative 3 would remove from the NARO South tract nine potential well sites. As of September 2001, Peabody Natural Gas, LLC had drilled two CBM wells on a private oil and gas lease within the NARO North LBA Tract as it is configured under the Proposed Action. These two wells are not currently producing. No CBM wells have been drilled on the NARO South LBA Tract.

WSO-RMG estimates that the average gas content in the NARO North LBA Tract is seven scf/ton. Based on that estimate, the recoverable CBM resource in the NARO North LBA Tract would be approximately 2.261

billion cubic feet under the Proposed Action. For the NARO South LBA Tract, WSO-RMG estimates that the average gas content is four scf/ton, and the estimated recoverable CBM resource is 0.964 billion cubic feet.

CBM will be produced by the existing CBM wells and other wells, if more are drilled, during the time it takes to lease and permit the LBA tracts and, on a case-by-case basis, until mining activity approaches each well. As indicated above, BLM's analysis suggests that substantial portions of these remaining reserves could be produced prior to initiation of mining activity on the NARO North and NARO South LBA Tracts under the Proposed Actions or Alternatives 2 or 3. CBM reserves that are not recovered prior to mining would be lost. This arrangement, which is dependent on cooperation between the oil and gas lessees and the coal lessees, allows for optimizing recovery of both resources.

Little Thunder LBA Tract

CBM is currently being produced on the Little Thunder LBA Tract as proposed and the area added under Alternative 2. As discussed in Section 3.11, 32 CBM wells have been completed for production within the lands encompassed by the Little Thunder LBA Tract, and most of the available 80-acre spacing units within the tract as proposed have been drilled. Review of WOGCC records on June 30, 2002 indicates that all but five of these wells have had some production.

WSO-RMG estimates that the average gas content in the Little Thunder LBA Tract is 14 scf/ton. Based on that estimate, the current recoverable CBM resource in the Little Thunder LBA Tract would be approximately 6.7 billion cubic feet.

CBM will be produced by the existing CBM wells and other wells, if more are drilled, during the time it takes to lease and permit the LBA tract and, on a case-by-case basis, until mining activity approaches each well. As indicated above, BLM's analysis suggests that substantial portions of these remaining reserves could be produced prior to initiation of mining activity on the Little Thunder LBA Tract under the Proposed Action or Alternatives 2 or 3. CBM reserves that are not recovered prior to mining would be lost. This arrangement, which is dependent on cooperation between the oil and gas lessees and the coal lessees, allows for optimizing recovery of both resources.

West Roundup LBA Tract

CBM is not currently being produced on the West Roundup LBA Tract as proposed or on the lands added under Alternatives 2 and 3 and by lease WYW-127221 modification. Under the Proposed Action, there would potentially be 28 well locations on the West Roundup LBA Tract if all the 80-acre spacing units within the tract were drilled. There would be nine more potential well sites on lands added by Alternative 2, and 14 more potential well sites on lands added by Alternative 3. As of September 2001, Independent Production Co., Inc. had four approved CBM well permits to drill on a private oil and gas lease within the West Roundup LBA Tract as it is

configured under the Proposed Action.

WSO-RMG estimates that the average gas content in the West Roundup LBA Tract is nine scf/ton. Based on that estimate, the current recoverable CBM resource in the West Roundup LBA Tract would be approximately 1.558 billion cubic feet.

CBM will be produced if wells are completed during the time it takes to lease and permit the LBA tract and, on a case-by-case basis, until mining activity approaches each well. As indicated above, BLM's analysis suggests that substantial portions of these remaining reserves could be produced prior to initiation of mining activity on the West Roundup LBA Tract under the Proposed Action or Alternatives 2 or 3. CBM reserves that are not recovered prior to mining would be lost. This arrangement, which is dependent on cooperation between the oil and gas lessees and the coal lessees, allows for optimizing recovery of both resources.

West Antelope LBA Tract

CBM is not currently being produced on the West Antelope LBA Tract as proposed or on the area added by Alternative 2. Under the Proposed Action, there would potentially be 47 well locations on the West Antelope LBA Tract if all the 80-acre spacing units within the tract were drilled. There would be four more potential well sites on lands added by Alternative 2, while Alternative 3 would remove from the West Antelope tract nine potential well sites.

WSO-RMG estimates that the average gas content in the West Antelope LBA Tract is nine scf/ton. Based on that estimate, the current recoverable CBM resource in the West Antelope LBA Tract would be approximately 2.645 billion cubic feet.

CBM will be produced if wells are completed during the time it takes to lease and permit the LBA tract and, on a case-by-case basis, until mining activity approaches each well. As indicated above, BLM's analysis suggests that substantial portions of these remaining reserves could be produced prior to initiation of mining activity on the West Antelope LBA Tract under the Proposed Action or Alternatives 2 or 3. CBM reserves that are not recovered prior to mining would be lost. This arrangement, which is dependent on cooperation between the oil and gas lessees and the coal lessees, allows for optimizing recovery of both resources.

4.1.3 Soils

Removal and replacement of soil resources during mining and reclamation would cause changes in soil resources. In general, soil chemistry and soil nutrient distribution would be more uniform, and average topsoil quality would be improved in reclaimed areas on the five LBA tracts because soil material that is not suitable to support plant growth would not be salvaged for use in reclamation. This would result in more uniform vegetative productivity on the reclaimed land. On each LBA tract, the replaced topsoil would support a stable and productive vegetation community adequate in quality and quantity to support the

planned postmining land uses (wildlife habitat and rangeland). There would be an increase in the near-surface bulk density of the reclaimed soil resources on each LBA tract. As a result, the average soil infiltration rates would generally decrease, which would increase the potential for runoff and soil erosion. Topographic moderation following reclamation would potentially decrease runoff, which would tend to offset the effects of decreased soil infiltration capacity. The change in soil infiltration rates would not be permanent because revegetation and natural weathering action would form a new soil structure in the reclaimed soils, and infiltration rates would gradually return to premining levels.

Direct biological impacts to reclaimed soil resources on each LBA tract considered in this EIS would include a short-term reduction in soil organic matter, microbial populations, seeds, bulbs, rhizomes, and live plant parts for soil resources that are stockpiled before placement.

Each mine would build sediment control structures as needed to trap eroded soil. Revegetation would reduce wind erosion, and soil or overburden materials containing potentially harmful chemical constituents (such as selenium) would be specially handled. These measures are required by state regulations and are therefore considered part of the Proposed Action and action alternatives. The previous discussion describes the impacts to soil resources that generally occur as a result of surface mining and reclamation. The following discussion is a description of potential impacts to soil resources on each LBA tract following reclamation under the Proposed Action or Alternatives 2 or 3.

NARO North and South LBA Tracts

Under the currently approved mining and reclamation plan, approximately 20,410 acres of soil resources will be disturbed in order to mine the coal in the existing leases at the North Antelope/Rochelle Complex (Table 4-1). If the NARO North and South LBA Tracts are leased, disturbance related to coal mining would directly affect an additional 5,590 acres of soil resources under the two Proposed Actions, or 6,275 acres under Alternative 2, or 4,863 acres under Alternative 3. Average topsoil thickness would be 20 to 39 inches across the entire reclaimed surface on both tracts. The types and quantities of soils that are present on the NARO North and NARO South LBA Tracts under the Proposed Action and Alternatives 2 and 3 are similar to soils currently being salvaged and utilized for reclamation on the existing North Antelope/Rochelle Complex coal leases.

Little Thunder LBA Tract

Under the currently approved mining and reclamation plan, approximately 18,476 acres of soil resources will be disturbed in order to mine the coal in the existing leases at the Black Thunder Mine (Table 4-2). If the Little Thunder LBA Tract is leased, disturbance related to coal mining would directly affect an additional 5,424 acres of soil resources on and adjacent to the tract under the Proposed Action, or 6,577 acres

under Alternative 2. Under Alternative 3, the total additional disturbance area would also equal 6,577 acres (1,382 acres would be disturbed to mine the North tract and 5,195 acres would be disturbed to mine the South tract). Average topsoil thickness would be about 18 inches across the entire reclaimed surface. The types of soils and the quantities of the soil resource included in the Little Thunder LBA Tract under the alternatives considered in this EIS are similar to the soils on the existing coal leases at the Black Thunder Mine.

West Roundup LBA Tract

Under the currently approved mining and reclamation plan, approximately 5,288 acres of soil resources will be disturbed in order to mine the coal in the existing leases at the North Rochelle Mine (Table 4-3). If the West Roundup LBA Tract is leased, disturbance related to coal mining would directly affect an additional 3,161 acres of soil resources under the Proposed Action, 3,161 acres under Alternative 2, 3,161 acres under Alternative 2 plus lease WYW-127221 modification, or approximately 3,591 acres under Alternative 3 with or without the lease WYW-127221 modification. Average topsoil thickness would be about 38 inches across the entire reclaimed surface. The types of soils and the quantities of the soil resource included in the West Roundup LBA Tract under the alternatives considered in this EIS are similar to the soils on the existing coal leases at the North Rochelle Mine.

West Antelope LBA Tract

Under the currently approved mining and reclamation plan, approximately 8,821 acres of soil resources will be disturbed in order to mine the coal in the existing leases at the Antelope Mine (Table 4-4). If the West Antelope LBA Tract is leased, disturbance related to coal mining would directly affect an additional 3,200 acres of soil resources on and adjacent to the LBA tract under the Proposed Action, 3,500 acres under Alternative 2, or 2,467 acres under Alternative 3. Average topsoil thickness would be about 19 inches across the entire reclaimed surface. The types of soils and the quantities of the soil resource included in the West Antelope LBA Tract under the alternatives considered in this EIS are similar to the soils on the existing leases at the Antelope Mine.

4.1.4 Air Quality

4.1.4.1 General Information

This section describes the impacts on air quality in the General Analysis Area. Specifically, this section deals with how the air quality impacts of mining the LBA tracts would be expected to differ from air quality impacts related to current mining operations in this area. For the purpose of impact assessment, mining the LBA tracts is considered to be a logical consequence of leasing the tracts. Thus, it is actually the impacts of mining on ambient air quality that are being assessed. The impacts of mining the LBA tracts, in conjunction with other activities, on air quality in the area are addressed in Section 4.5.4.

As discussed in Section 3.5, a Wyoming air permit application is required to demonstrate that BACT is utilized to control emissions and that the proposed activities will not cause or significantly contribute to an exceedance of the ambient air quality standards. The demonstration of compliance is typically made with emission inventories and dispersion modeling. Impacts to air quality from mining the LBA tracts included in this analysis can be inferred from the impact demonstrations for currently permitted mining in the vicinity. Impacts would primarily result from emissions of particulates and NO_2. As discussed in Section 3.5.3, there are numerous activities in and around the LBA tracts that produce particulates and NO_2.

Particulates include solid particles and liquid droplets that can be suspended in air. Section 3.5.4 describes historical regional and site-specific particulate levels. Particulates, especially fine particles, have been linked to numerous respiratory-related illnesses and can adversely affect individuals with pre-existing heart or lung disease. They are also a major cause of visibility impairment in many parts of the United States. While individual particles cannot be seen with the naked eye, collectively they can appear as black soot, dust clouds, or gray hazes. Impacts to the particulate annual ambient air quality standard are discussed separately for each LBA tract in the following sections.

NO_2 is a product of incomplete combustion at sources such as gasoline and diesel burning engines or from mine blasting activities. Gaseous NO_2 is reddish-brown, heavier than air and has a pungent odor. It is highly reactive and combines with water to form nitric acid and nitric oxide. "Nitrogen dioxide gas may cause significant toxicity because of its ability to form nitric acid with water in the eye, lung, mucous membranes, and skin" (EPA 2001). Acute exposure may cause death by damaging the pulmonary system. "Chronic or repeated exposure to lower concentrations of NO_2 may exacerbate pre-existing respiratory conditions, or increase the incidence of respiratory infections" (EPA 2001). Impacts to the NO_2 annual ambient air quality standard are discussed separately for each LBA tract in the following sections.

There is no NAAQS for NO_2 for periods shorter than one year. Concern that there may be a health risk associated with short-term exposure to NO_2 from blasting emissions prompted a study conducted in August 1999 and completed in April 2000 by the WMA with participation from the WDEQ/LQD and WDEQ/AQD.

The study involved collection of 15-minute average NO_2 concentrations in areas accessible to the public near PRB coal mining operations. It was designed to help evaluate possible exposure of the public to NO_2 emissions resulting from blasting activity at surface coal mines. Six monitor locations were selected "…based on their proximity to mining activity and accessibility to the public. Roads adjacent to mining activity were felt to be areas where the public exposure would most likely

occur. Locations were also chosen based on dominant wind direction, and to represent areas having the greatest chance of being impacted by several mining operations" (WMA 2000).

The report presents ambient NO_2 concentrations in the vicinity of the mines, associated blasting information, meteorological data as well as why certain decisions were made in the design of the study. A brief summary of the findings follows.

- Approximately 95 percent of the valid data points were readings of 0 ppm (0 $\mu g/m^3$) NO_2.

- The maximum 15-minute average valid values observed for each of the six monitors ranged from 0 to 1.65 ppm (0-3,102 $\mu g/m^3$) NO_2.

- Where readings greater than 0 ppm did occur there was a strong correlation between NO_2 readings and temperatures. This correlation indicates that the NO_2 readings may have been inflated due to temperature considerations.

NIOSH, OSHA, and EPA short-term exposure criteria help put these numbers into perspective. NIOSH's recommended Immediately Dangerous to Life and Health level is 20 ppm (37,600 $\mu g/m^3$). OSHA's Short-Term Exposure Limit, a 15-minute time-weighted average, is five ppm (9,400 $\mu g/m^3$). The EPA Significant Harm Level, a one-hour average, is two ppm (3,760 $\mu g/m^3$). However, according to EPA "…the exact concentrations at which NO_2 will cause various health effects cannot be predicted with complete accuracy because the effects are a function of air concentration and time of exposure, and precise measurements have not been made in association with human toxicity. The information that is available from human exposures also suggests that there is some variation in individual response" (EPA 2001).

In conclusion:

- NO_2 is being actively monitored in the PRB and reported for compliance with the NAAQS annual standard;

- Monitored NO_2 levels are below the NAAQS annual standard; and

- Short-term NO_2 monitoring in areas of public exposure show levels below NIOSH, OSHA, and EPA's short-term exposure criteria.

There are no state or federal rules that state the public or employees must stay back a certain distance from mine blasting operations in order to limit their exposure to NO_2. Pursuant to an order by the WDEQ, a study was developed to assist the WDEQ establish a safe setback distance from blasting operations at PRB mines. The study, co-sponsored by all of the coal mining companies in the PRB, was overseen and compiled by McVehil-Monnett Associates, Inc. of Englewood, Colorado. The analysis was released in July 2002 and it was based on the results of 76 mine blasts fully measured by TBCC at the Black

Thunder Mine over a 14-month period of time. A formula was developed to calculate safe setback distances for varying amounts of explosives, wind speeds, and type of blast (coal, overburden conventional, or overburden cast). According to the study, a minimum setback distance of 750 feet (coal) to 1,000 feet (overburden) will protect the public from exposure to NO_2 (The Sheridan Press 2002).

This analysis also included a toxicological study by Dr. Edward Faeder, consultant to TBCC on human health impacts from short-term exposure to NO_2. In reviewing this study, EPA expressed significant concern with this report (EPA 2002b). According to EPA's review, Dr. Faeder's report recommends that a 10-minute exposure to a level of five ppm would be "protective of even sensitive subsets of the normal population if the exposure frequence is one to three times a year," while EPA's professional judgment is that "if a concentration of 0.5 ppm were not exceeded, healthy persons would not experience adverse health effects and the most sensitive persons would probably not experience adverse health effects from NO_2". The Wyoming Environmental Quality Council has recently been considering the issue of safe setback distances from blasting operations at surface coal mines (Casper Star Tribune, October 23, 2002).

As discussed in Section 3.5.7, PSD is not an issue to coal mining. However, BLM evaluates such issues for leasing. Regional air quality impacts for this EIS are evaluated under cumulative impacts (Section 4.5.4).

4.1.4.2 NARO North and South LBA Tracts

Air Quality Impacts from Currently Permitted Operations

WDEQ/AQD issued air quality permit MD-657 for the North Antelope/Rochelle Complex on August 14, 2001. This air quality permit reflects analyses based on a maximum coal production of 105 mmtpy. Material movement utilizes draglines, shovels, and trucks in overburden, and shovels, trucks, and conveyors in coal.

Particulate emission inventories for the mining activities at North Antelope/Rochelle Complex were prepared for all years in the currently anticipated life of the mine. Two years, 2001 and 2006, were then selected for worst-case dispersion modeling of PM_{10}. Dispersion modeling was performed for projected mining at North Antelope/Rochelle Complex using the FDM for area and line sources and the ISCLT3 Model for point sources. In accordance with WDEQ policy for modeling coal mining impacts, a PM_{10} concentration of 15 $\mu g/m^3$ was added to all modeled emissions to account for background fugitive dust. The resulting particulate levels were then compared to the average annual PM_{10} standard of 50 $\mu g/m^3$ to determine compliance with the annual NAAQS. This constitutes a demonstration of compliance with the "long-term" or annual NAAQS.

Long-term modeling indicated the currently projected mine activities would be in compliance with the annual PM_{10} ambient air standard for

the currently anticipated life of the mine, at the proposed production rates. The highest PM_{10} level modeled in 2001 was 38.53 $\mu g/m^3$. In that year, the annual coal tonnage level was only 77 million tons but the pits were all in close proximity and close to the northern ambient air boundary. In 2006 the annual coal production was the maximum permitted production level of 105 million tons. This year showed the highest particulate level in the emission inventory. The dispersion model showed a maximum concentration of 49.94 $\mu g/m^3$ for 2006. The locations of the maximum-modeled PM_{10} concentrations are shown on Figures 4-1 and 4-2.

In Wyoming, monitoring results have been used in lieu of short-term (24-hour) modeling for assessing short-term coal mining-related impacts in the PRB. WDEQ has chosen this procedure in accordance with an agreement between EPA and the State. That agreement recognizes that appropriate models do not exist to accurately predict 24-hour impacts.

The validity of using this permit analysis for predicting impacts from the LBA tracts can be established by a comparison with current conditions at the mine. There have been no exceedances of the PM_{10} 24-hour NAAQS at North Antelope/Rochelle Complex through 2001. It is unlikely that North Antelope/Rochelle Complex has had a large contribution (> one $\mu g/m^3$) to the recent exceedances experienced at other mines. They are complying with the increased monitoring frequency and cooperating with WDEQ/AQD to try to determine the causes of PM_{10} 24-hour exceedances at other locations. BACT measures being utilized to control particulate emissions at North Antelope/Rochelle Complex are described in Section 3.5 of this document.

As discussed in Section 3.5, NO_2 is produced by some of the emission-producing activities in the vicinity of the LBA tracts. North Antelope/Rochelle Complex was not required to conduct NO_2 dispersion modeling in their most recent permit. This is because WDEQ determined in 1997 that NO_2 levels in the PRB do not threaten the ambient air standard. However, North Antelope/Rochelle Complex is participating in the regional NO_2 monitoring network. NO_2 monitoring results through 1996 are shown on Table 3-3 and the 2001 monitoring results are given in Table 3-4. Monitoring results for 1997 through 2001 are available through WDEQ/AQD. The agency is relying on those monitoring data and emission inventories in permit applications to demonstrate compliance with the annual NO_2 ambient air standard (Table 3-1).

Section 4.1.4.1 provides a discussion of short-term NO_2 concentrations in areas of public exposure. There is no NAAQS that regulates short-term NO_2 levels. There have been no reported events of public exposure to NO_2 from blasting activities at the North Antelope/Rochelle Complex through 2001. The mine has, however, employed measures to control/limit public exposure to intermittent, short-term (blasting) releases as

Figure 4-1

Figure 4-2

discussed in Section 3.5 of this document.

Air Quality Impacts from Proposed Action and Alternatives

The impacts to air quality from mining the NARO North and South LBA Tracts have been inferred from the impacts at the currently permitted mining operation. Twenty-four-hour impacts have been estimated from recent monitoring and emission control activities. This section deals with how the air quality impacts of mining the LBA tracts as proposed would differ from the currently permitted impacts of mining the existing leases at the North Antelope Rochelle Complex. There have been no exceedances of the 24-hour or annual ambient air standards at the North Antelope/Rochelle Complex through 2001. None are expected from mining the LBA tracts, as discussed below.

The NARO North and South LBA Tracts would be mined as an integral part of the North Antelope/Rochelle Complex. The impacts to air quality under the No Action Alternative would be the same as those currently permitted. The impacts to air quality under the Proposed Action, Alternative 2, or Alternative 3 would be expected to increase. Coal production without the NARO North and NARO South LBA Tracts is projected to average around 75 mmtpy. With the NARO North and NARO South LBA Tracts, coal production is anticipated to average around 90 mmtpy. Coal thickness in the LBA tracts is similar to the current lease areas, however, the average overburden thickness in the LBA tracts is greater (approximately 10 percent) than within the current lease. As a result, an increase in emissions is anticipated from increased production, increased overburden movement, and increased blast frequency. The overburden haul distance and related emissions are not expected to change, however, the coal haul lengths would be anticipated to increase as mining progresses farther from crushing facilities, resulting in a corresponding increase in coal haulage emissions. Material movement would continue to utilize draglines, shovels, and trucks in overburden and shovels and trucks in coal. Near-pit crushers and overland conveyors would continue to be utilized resulting in reduced coal haulage emissions. A facilities expansion is planned according to the current air quality permit, however, expansion of the facilities is not dependent on acquisition of the LBA tracts. There are no plans to change blasting procedures or blast sizes if the LBA tracts are leased and mined. Current BACT measures for particulates and for NO_2 would continue to be employed.

The additional coal from the LBA tracts would allow mining operations to continue for a longer period of time, ranging from two to 4.5 additional years depending upon the action alternative that is selected.

In summary, increases in emissions from current levels are expected if the NARO North and South LBA Tracts are mined; however, air quality impacts from mining the NARO North and South LBA Tracts by the applicant should be within daily and annual NAAQS limits. Modeling for

the current North Antelope/Rochelle Complex permit predicted no exceedances of the annual PM_{10} NAAQS at a 105 mmtpy production rate and there have been no exceedances of the 24-hour PM_{10} NAAQS. The anticipated average coal production levels of 90 mmtpy are below the currently permitted levels, which were used in the modeling.

4.1.4.3 Little Thunder LBA Tract

Air Quality Impacts from Currently Permitted Operations

WDEQ/AQD issued air quality permit MD-417 for the Black Thunder Mine on July 1, 1999. This air quality permit reflects analyses based on a maximum coal production of 100 mmtpy as well as permitted production from neighboring mines and permitted sources in close proximity to the mine. Material movement utilizes draglines, shovels and trucks in overburden, and shovels, trucks, and conveyors in coal.

Particulate emission inventories for the mining activities at Black Thunder Mine were prepared for all years in the currently anticipated life of the mine. Two years, 2002 and 2026, were then selected for worst-case dispersion modeling of PM_{10}. Dispersion modeling was performed for projected mining at Black Thunder Mine and emissions from other existing and permitted sources in the area including North Rochelle and Jacobs Ranch Mines, Two Elk power generating station and the ENCOAL Liquids from Coal and power generating facility. Area and line sources were modeled using the FDM and the ISCLT3 Model was used for point surfaces. In accordance with WDEQ policy for modeling coal mining impacts, a PM_{10} concentration of 15 $\mu g/m^3$ was added to all modeled emissions to account for background fugitive dust. The resulting particulate levels were then compared to the average annual PM_{10} standard of 50 $\mu g/m^3$ to determine compliance with the annual NAAQS. This constitutes a demonstration of compliance with the "long-term" or annual NAAQS.

The long-term modeling indicated that currently projected mining activities, in conjunction with other existing and permitted activities in the area, would be in compliance with the annual PM_{10} ambient air standard for the life of the mine. Year 2002 was expected to have the highest combined impacts from all three mines, largely due to the close proximity of Black Thunder Mine's North and West pits and Jacob Ranch Mine's pit to the respective ambient air boundaries. The highest PM_{10} level modeled in 2002 was 34.96 $\mu g/m^3$. Year 2026 was selected as the second year for dispersion modeling. Particulate emissions in this year were the highest in the emission inventory and Black Thunder's mining activity was near the ambient air boundary. The annual coal production was also at the maximum permitted production level of 100 million tons. The dispersion model showed a maximum concentration of 34.58 $\mu g/m^3$ for 2026. The locations of the maximum-modeled PM_{10} concentrations are shown on Figures 4-3 and 4-4.

Figure 4-3

Figure 4-4

In Wyoming, monitoring results have been used in lieu of short-term (24-hour) modeling for assessing short-term coal mining-related impacts in the PRB. WDEQ has chosen this procedure in accordance with an agreement between EPA and the State. That agreement recognizes that appropriate models do not exist to accurately predict 24-hour impacts.

The validity of using this permit analysis for predicting impacts from the LBA tract can be established by a comparison with current conditions at the mine. There were no exceedances of the PM_{10} 24-hour NAAQS at Black Thunder Mine through 2001. During 2002 there was one exceedance of the PM_{10} 24-hour NAAQS at one of the Black Thunder Mine's air quality monitoring sites. This exceedance occurred during a period when winds reached at least 25 mph for a one-hour period. The exceedance may be the result of increased background dust levels combined with specific mine activities during high wind conditions. In addition to the BACT measures discussed in Section 3.5 of this document, the mine has increased its monitoring frequency and has worked with WDEQ/AQD to develop and implement plans to reduce emissions on high wind days. Actions that the mine is implementing include elimination of unnecessary roads, periodic application of magnesium chloride and surfactants to roads, reducing the dump height of the draglines, and increasing efforts for timely reclamation of disturbed areas. The one exceedance of the PM_{10} 24-hour standard did not constitute a violation of the NAAQS. A violation would require a second exceedance in one year. There have been no exceedances of the PM_{10} annual NAAQS.

As discussed in Section 3.5, NO_2 is produced by some of the emission-producing activities in the vicinity of the LBA tract. Black Thunder Mine was not required to conduct NO_2 dispersion modeling in their most recent permit. This is because WDEQ determined in 1997 that NO_2 levels in the PRB do not threaten the ambient standard. However, Black Thunder Mine is participating in the regional NO_2 monitoring network. NO_2 monitoring results through 1996 are shown on Table 3-3 and the 2001 monitoring results are shown in Table 3-4. Monitoring results for 1997 through 2001 are available through WDEQ/AQD. The agency is relying on those monitoring data and emission inventories in permit applications to demonstrate compliance with the annual NO_2 ambient air standard (Table 3-1).

Section 4.1.4.1 provides a discussion of short-term NO_2 concentrations in areas of public exposure. There is no NAAQS that regulates short-term NO_2 levels. Black Thunder Mine received several reports of public exposure to NO_2 from blasting prior to 2001. Measures were developed to control/limit public exposure to intermittent, short-term (blasting) releases as discussed in Section 3.5. Black Thunder Mine has also experimented with procedures and materials designed to reduce the production of NO_2 from blasting. No reports of public exposure to NO_2 have been received since early 2001.

Air Quality Impacts from Proposed Action and Alternatives

The annual impacts to air quality from mining the Little Thunder LBA Tract have been inferred from the modeled impacts at the currently permitted mining operation. Twenty-four-hour impacts have been estimated from recent monitoring and emission control activities. This section deals with how the air quality impacts of mining the LBA tract differ from the currently permitted impacts of mining the existing coal leases at the Black Thunder Mine. One 24-hour PM_{10} exceedance has occurred and Black Thunder Mine is investigating the exceedance of the 24-hour standard in cooperation with the WDEQ/AQD and remedies are being developed and implemented. These are expected to reduce emissions from the mine to within the 24-hour NAAQS limit. There have been no exceedances of the annual PM_{10} standard, and none are expected from mining the LBA tract, as discussed below.

Recent meteorology could be a significant contributor to the 24-hour exceedance that was measured at one of the Black Thunder Mine's air quality monitoring sites in 2002. Three years of drought conditions coupled with stronger winds may be transporting more dust from upwind sources, resulting in a higher background dust level than in more normal meteorological conditions. The meteorology for the period December 2001 through February 2002 shows abnormally high average wind speeds at the neighboring North Rochelle Mine. During this period, average wind speeds were nearly 50 percent and 35 percent higher than the same period in the previous two years when average speeds of 10.0 and 12.23 mph, respectively, were recorded. It is very likely that a similar increase in wind speeds has been experienced at the Black Thunder Mine.

The No Action Alternative is identical to the currently permitted operation; therefore, the impacts to air quality under Alternative 1 would be the same as those currently permitted. The Proposed Action, Alternative 2, and Alternative 3 all involve mining the LBA tract as an integral part of the Black Thunder Mine. The only differences between the Alternatives are in size of the lease area and timing of lease sales/mining.

If the Little Thunder LBA Tract is mined as proposed under the Proposed Action and Alternatives 2 and 3, a net increase in total emissions of particulates and NO_2 as compared to the currently permitted operation would be expected. Maximum coal production is anticipated to be 68.5 mmtpy regardless of whether or not the Little Thunder LBA Tract is acquired. Emissions from the coal extraction-related processes should actually decrease on an annual basis although they would be extended for an additional eight to 10.7 years. The decrease would occur because as the coal seam thickness increases in the LBA tract, the operation would advance through the property more slowly. This would decrease the acres disturbed annually, cause coal haul distances to increase more slowly, and require fewer blasts per ton of coal extracted. However, the

increasing overburden-to-coal ratio of the LBA tract is expected to more than offset these decreases. With a 46 percent increase in overburden thickness, overburden extraction and haulage would generate more emissions per ton of coal mined than are modeled in the current permit.

Coal removal would continue to be performed with shovels and trucks. Additional near-pit crusher and conveyor systems would be constructed if the LBA tract is acquired. This would serve to keep coal haul distances similar to haul distances without the LBA tract. The overburden haul distance and related emissions are not expected to change because the method of mining would not change. Overburden movement would continue to utilize draglines, shovels, and trucks. There are no plans to change blasting procedures or blast sizes associated with the mining of this LBA tract. In addition, current BACT measures for particulates and for NO_2 would continue to be employed.

In summary, emissions associated with mining the Little Thunder LBA Tract are expected to increase over those modeled in the current air permit. Black Thunder Mine in conjunction with WDEQ/AQD is developing improvements in emission control activities to remedy current elevated levels of emissions. The mine anticipates that these improvements in emission control activities would allow permitting the LBA tract at a maximum production of 100 mmtpy. In the event that compliance cannot be demonstrated in a permit for 100 mmtpy, a lower annual production rate and/or further expansion of emission control activities at the mine would have to be evaluated for compliance prior to approval of mining operations on the Little Thunder LBA Tract.

4.1.4.4 West Roundup LBA Tract

Air Quality Impacts from Currently Permitted Operations

WDEQ/AQD issued air quality permit MD-454 for the North Rochelle Mine on May 5, 2000. This air quality permit reflects analyses based on a maximum coal production of 35 mmtpy as well as permitted production from neighboring mines and permitted sources in close proximity to the mine. Material movement utilizes draglines, shovels and trucks in overburden, and shovels, trucks, and conveyors in coal.

Particulate emission inventories for the mining activities at North Rochelle Mine were prepared for all years in the currently anticipated life of the mine. Two years, 2002 and 2012, were then selected for worst-case dispersion modeling of PM_{10}. Dispersion modeling was performed for projected mining at North Rochelle Mine and emissions from other existing and permitted sources in the area including Black Thunder and Jacobs Ranch Mines, Two Elk power generating station, and the ENCOAL Liquids from Coal and power generating facility. Area and line sources were modeled using the FDM and the ISCLT3 Model was used for point sources. In accordance with WDEQ policy for modeling coal mining impacts, a PM_{10} concentration of 15 $\mu g/m^3$ was added to all modeled

emissions to account for background fugitive dust. The resulting particulate levels were then compared to the average annual PM_{10} standard of 50 $\mu g/m^3$ to determine compliance with the annual NAAQS. This constitutes a demonstration of compliance with the "long-term" or annual NAAQS.

The long-term modeling indicated that currently projected mining activities, in conjunction with other existing and permitted activities in the area, would be in compliance with the annual PM_{10} ambient air standard for the life of the mine. Year 2002 was expected to have the highest combined impacts from all three mines, largely due to the close proximity of Black Thunder Mine's South Pit and North Rochelle Mine's Pit 1. The highest PM_{10} level modeled in 2002 was 33.9 $\mu g/m^3$. Year 2012 was selected as the second year for dispersion modeling. Particulate emissions in this year were nearly identical to the peak year (2005) in the emission inventory and North Rochelle's mining activity was near the ambient air boundary. The annual coal production was also at the maximum permitted production level of 35 million tons. The dispersion model showed a maximum concentration of 42.7 $\mu g/m^3$ for 2012. The locations of the maximum-modeled PM_{10} concentrations are shown on Figures 4-5 and 4-6.

In Wyoming, monitoring results have been used in lieu of short-term (24-hour) modeling for assessing short-term coal mining-related impacts in the PRB. WDEQ has chosen this procedure in accordance with an agreement between EPA and the State. That agreement recognizes that appropriate models do not exist to accurately predict 24-hour impacts.

The validity of using this permit analysis for predicting impacts from the LBA tract can be established by a comparison with current conditions at the mine. There were no exceedances of the PM_{10} 24-hour NAAQS at North Rochelle Mine through 2000. During 2001 and early 2002, there have been a total of 10 exceedances of the PM_{10} 24-hour NAAQS at North Rochelle Mine's air quality monitoring sites. All of these exceedances occurred during periods when winds reached at least 25 mph for a one-hour period.

Two of these exceedances appear to be directly related to dust generated from an unpaved county road that was relocated to within 500 ft of one of the monitors. Because the road relocation occurred after the monitor was in place, the WDEQ/AQD has requested that a new monitor location be developed further from the road. In addition, the mine has treated the road with chemical stabilizers to reduce dust.

The remaining exceedances appear to be the result of increased background dust levels and mine site wind erosion during high wind conditions. In addition to the BACT measures discussed in Section 3.5, the mine has increased its monitoring frequency and has worked with WDEQ/AQD to develop an ongoing compliance plan for controlling particulates. Part of the compliance plan involves determining the causes of the exceedances and possible

Figure 4-5

Figure 4-6

solutions. Specific measures implemented at the North Rochelle Mine so far include chemical stabilization of disturbed ground, surface roughening through creation of windrows, and mulching and crimping activities. These measures are being implemented on disturbed acres susceptible to wind scouring including stockpiles, areas stripped for mine advance, and areas being brought to final grade. In addition, the mine is inter-seeding areas where the recent drought has hindered revegetation success.

As discussed in Section 3.5 of this document, NO_2 is produced by some of the emission-producing activities in the vicinity of the LBA tract. North Rochelle Mine was not required to conduct NO_2 dispersion modeling in their most recent permit. This is because WDEQ determined in 1997 that NO_2 levels in the PRB do not threaten the ambient standard. However, North Rochelle Mine is participating in the regional NO_2 monitoring network. NO_2 monitoring results through 1996 are shown on Table 3-3 and the 2001 monitoring results are given in Table 3-4. Monitoring results for 1997 through 2001 are available through WDEQ/AQD. The agency is relying on those monitoring data and emission inventories in permit applications to demonstrate compliance with the annual NO_2 ambient air standard (Table 3-1).

Section 4.1.4.1 provides a discussion of short-term NO_2 concentrations in areas of public exposure. There is no NAAQS that regulated short-term NO_2 levels. There have been no reported events of public exposure to NO_2 from blasting activities at the North Rochelle Mine through 2001. The mine has, however, employed measures to control/limit public exposure to intermittent, short-term (blasting) releases as discussed in Section 3.5.

Air Quality Impacts from Proposed Action and Alternatives

The annual impacts to air quality from mining the West Roundup LBA Tract have been inferred from the modeled impacts at the currently permitted mining operation. Twenty-four-hour impacts have been estimated from recent monitoring and emission control activities. Several 24-hour PM_{10} exceedances have occurred and North Rochelle Mine is investigating exceedances of the 24-hour standard in cooperation with the WDEQ/AQD and remedies are being developed and implemented. These are expected to reduce emissions from the mine to within the 24-hour NAAQS limit. There have been no exceedances of the annual PM_{10} standard, and none are expected from mining the LBA tract, as discussed below.

Recent meteorology could be a significant contributor to the 24-hour exceedances experienced. Three years of drought conditions coupled with stronger winds may be transporting more dust from upwind sources, resulting in a higher background dust level than in more normal meteorological conditions. The meteorology for the period December 2001 through February 2002 shows abnormally high average wind speeds. During this period, average wind speeds of 16.4 mph

were recorded at the North Rochelle Mine meteorological site. This is nearly 50 percent and 35 percent higher than the same period in the previous two years when average speeds of 10.0 and 12.23 mph, respectively, were recorded.

The No Action Alternative is identical to the currently permitted operation; therefore, the impacts to air quality under Alternative 1 would be the same as those currently permitted. The Proposed Action, Alternative 2, and Alternative 3 all involve mining the LBA tract as an integral part of the North Rochelle Mine. The only differences are in size of the lease area.

The Proposed Action and Alternatives 2 and 3 are expected to result in a net increase in total emissions of particulates and NO_2 as compared to the currently permitted operation. Coal production is anticipated to be approximately 35 mmtpy regardless of whether or not the West Roundup LBA Tract is acquired. Emissions from the coal extraction-related processes should actually decrease on an annual basis although they would be extended for an additional 4.5 to 6.7 years. The decrease would occur because as the coal seam thickness increases in the LBA tract, the operation would advance through the property more slowly. This would decrease the acres disturbed annually, cause coal haul distances to increase more slowly, and require fewer blasts per ton of coal extracted. However, the increasing overburden-to-coal ratio of the LBA tract is expected to more than offset these decreases. With a nearly 50 percent increase in overburden thickness, overburden extraction and haulage would generate more emissions per ton of coal mined than are modeled in the current permit.

The overburden haul distance and related emissions are not expected to change. Material movement would continue to utilize draglines, shovels and trucks in overburden, and shovels and trucks in coal. Near-pit crushers and overland conveyors would continue to be utilized resulting in reduced coal haulage emissions. There are no plans to change blasting procedures or blast sizes associated with the mining of this LBA tract. In addition, current BACT measures for particulates and for NO_2 would continue to be employed.

In summary, emissions associated with mining the West Roundup LBA Tract are expected to increase over those modeled in the current air permit. North Rochelle Mine in conjunction with WDEQ/AQD is developing improvements in emission control activities to remedy current elevated levels of emissions. These improvements may not be enough to allow permitting the LBA tract at a maximum production of 35 mmtpy. It is likely, however, that a permit can be obtained with a lower annual production rate and/or further expansion of emission control activities at the mine.

4.1.4.5 West Antelope LBA Tract

Air Quality Impacts from Currently Permitted Operations

WDEQ/AQD issued air quality permit MD-616 for the Antelope Mine on

April 30, 2001. This air quality permit reflects analyses based on a maximum coal production of 32 mmtpy. Material movement utilizes draglines, shovels and trucks in overburden, and shovels, trucks, and conveyors in coal.

Particulate emission inventories for the mining activities at Antelope Mine were prepared for all years in the currently anticipated life of the mine. Two years, 2006 and 2016, were then selected for worst-case dispersion modeling of PM_{10}. Dispersion modeling was performed for projected mining at Antelope Mine. Area and line sources were modeled using the FDM and the ISCLT3 Model was used for point sources. In accordance with WDEQ policy for modeling coal mining impacts, a PM_{10} concentration of 15 $\mu g/m^3$ was added to all modeled emissions to account for background fugitive dust. The resulting particulate levels were then compared to the average annual PM_{10} standard of 50 $\mu g/m^3$ to determine compliance with the annual NAAQS. This constitutes a demonstration of compliance with the "long-term" or annual NAAQS.

Long-term modeling indicated the currently projected mine activities will be in compliance with the annual PM_{10} ambient air standard for the life of the mine. The worst-case years were selected on having the highest PM_{10} emissions in the emissions inventory. The dispersion model showed a maximum concentration of 47.3 $\mu g/m^3$ in 2006 and 49.2 $\mu g/m^3$ in 2016. Coal production in both years was the maximum permitted production level of 32 million tons. The locations of the maximum-modeled PM_{10} concentrations are shown on Figures 4-7 and 4-8.

In Wyoming, monitoring results have been used in lieu of short-term (24-hour) modeling for assessing short-term coal mining-related impacts in the PRB. WDEQ has chosen this procedure in accordance with an agreement between EPA and the State. That agreement recognizes that appropriate models do not exist to accurately predict 24-hour impacts.

The validity of using this permit analysis for predicting impacts from the LBA tract can be established by a comparison with current conditions at the mine. There have been no exceedances of the PM_{10} 24-hour NAAQS at Antelope Mine through 2001. It is unlikely that operations at the Antelope Mine have made a major contribution (> one $\mu g/m^3$) to the recent exceedances experienced at other mines in the General Analysis Area. However, they are complying with the increased monitoring frequency and cooperating with WDEQ/AQD to try to determine the causes of PM_{10} 24-hour exceedances at other locations. BACT measures being utilized to control particulate emissions at Antelope Mine are described in Section 3.5 of this document.

As discussed in Section 3.5, NO_2 is produced by some of the emission-producing activities in the vicinity of the LBA tract. Antelope Mine was not required to conduct NO_2 dispersion modeling in their most recent permit. This is because WDEQ determined in 1997 that NO_2 levels in the PRB do not threaten the ambient air

Figure 4-7

Figure 4-8

standard. However, Antelope Mine is participating in the regional NO_2 monitoring network. NO_2 monitoring results through 1996 are shown on Table 3-3 and the 2001 monitoring results are given in Table 3-4. Monitoring results for 1997 through 2001 are available through WDEQ/AQD. The agency is relying on those monitoring data and emission inventories in permit applications to demonstrate compliance with the annual NO_2 ambient air standard (Table 3-1).

Section 4.1.4.1 provides a discussion of short-term NO_2 concentrations in areas of public exposure. There is no NAAQS that regulates short-term NO_2 levels. There have been no reported events of public exposure to NO_2 from blasting activities at the Antelope Mine through 2001. The mine has, however, employed measures to control/limit public exposure to intermittent, short-term (blasting) releases as discussed in Section 3.5 of this document.

Air Quality Impacts from Proposed Action and Alternatives

The impacts to air quality from mining the West Antelope LBA Tract have been inferred from the impacts at the currently permitted mining operation. Twenty-four-hour impacts have been estimated from recent monitoring and emission control activities. This section deals with how the air quality impacts of mining the LBA tract differ from the currently permitted impacts. There have been no exceedances of the 24-hour or annual ambient air standards at the Antelope Mine through 2001. None are expected from mining the LBA tract as discussed below.

The West Antelope LBA Tract would be mined as an integral part of the Antelope Mine. The impacts to air quality under the No Action Alternative would be the same as those currently permitted. The impacts to air quality under the Proposed Action or Alternative 2 or 3 are described below. Coal production is anticipated to increase to a maximum rate of 32 mmtpy, then fall off during the mine's later years with or without the West Antelope LBA Tract. If the mine acquires the additional coal in the LBA tract, they would produce at a rate of 32 mmtpy for a longer period of time but the life of mine would not be extended. As a result, the increased emissions due to coal and overburden removal operations (i.e., haulage, blasting, etc.) at the 32 mmtpy production rate would occur for a longer period of time than is shown in the current approved air quality permit. The overburden haul distance and related emissions are not expected to change, however, the average overburden thickness in the LBA tract is greater than within the current lease (approximately a 12 percent increase). Thus, an increase in emissions would be anticipated from increased overburden movement and blast frequency. This may be moderated somewhat because the coal thickness in the LBA tract is somewhat greater than in the current lease areas. This would decrease the acres disturbed annually, cause coal haul distances to increase more slowly, and require fewer blasts per ton of coal extracted.

Material movement would continue to utilize draglines, shovels, and trucks in overburden, and shovels and trucks in coal. Near-pit crushers and overland conveyors would continue to be utilized resulting in reduced coal haulage emissions. Facilities shown in the current air quality permit would not change as a result of proposed mining of the LBA tract. There are no plans to change blasting procedures or blast sizes associated with the mining of the LBA tract. In addition, current BACT measures for particulates and for NO_2 would continue to be employed.

In summary, if the Antelope Mine acquires and mines the West Antelope LBA Tract, increases in emissions from current levels are expected due to an increase in the time the mine would produce at a rate of 32 mmtpy and an increase in overburden thickness. The increases would be moderated somewhat by a slower rate of advance through the tract due to the greater coal thickness in the LBA tract. Modeling for the current Antelope Mine permit showed no exceedances of the annual PM_{10} NAAQS at a 32 mmtpy production rate and there have been no exceedances of the 24-hour PM_{10} NAAQS. Therefore, air quality impacts that result from mining the West Antelope LBA Tract by the applicant should also be within daily and annual NAAQS limits.

4.1.5 Water Resources

Surface Water

Changes in runoff characteristics and sediment discharges would occur during mining of each of the LBA tracts as a result of the destruction and reconstruction of drainage channels as mining progresses. Erosion rates could be high on the disturbed areas because of vegetation removal. However, both state and federal regulations require that all surface runoff from mined lands be treated as necessary to meet effluent standards. Generally, the surface runoff sediment is deposited in ponds or other sediment control devices inside the permit area.

Since the LBA tracts would be mined as extensions of existing mines under the Proposed Actions or action alternatives, there would not be a major change in the size of area that is disturbed and not reclaimed at any given time as a result of leasing these tracts. WDEQ/LQD would also require monitoring programs to assure that ponds would always have adequate space reserved for sediment accumulation.

The presence of disturbed areas creates a potential that sediment produced by large storms (i.e., greater than the 10-year, 24-hour storm) could potentially adversely impact areas downstream of the mining operations. This potential for adverse downstream impacts would be extended if the LBA tracts are leased.

The loss of soil structure would act to increase runoff rates on the LBA tracts in reclaimed areas. However, the general decrease in average slope in reclaimed areas, as discussed in Section 4.1.1, would tend to counteract the potential for an increase in runoff. Soil structure would gradually reform over time, and vegetation (after successful

reclamation) would provide erosion protection from raindrop impact, retard surface flows, and control runoff at approximately premining levels.

After mining and reclamation are complete, surface water flow, quality, and sediment discharge from the LBA tracts would approximate premining conditions. The impacts described above would be similar for the Proposed Actions and action alternatives, and they are similar to the expected impacts for currently permitted mining operations. Direct and indirect impacts to the surface water system resulting from mining the five LBA tracts would add to the cumulative impacts that will occur due to mining existing leases. These impacts are discussed in Section 4.5.5. Following is a description of surface water impacts from the leasing and subsequent mining of each of the LBA tracts under the Proposed Action or Alternative 2 or 3.

NARO North and South LBA Tracts

The NARO North LBA Tract may encounter significant runoff in Porcupine Creek, which is ephemeral to intermittent in the vicinity of the tract. A section of Porcupine Creek is currently diverted around active pits in the North Antelope/Rochelle Complex. During mining, hydrologic control within the NARO North LBA Tract would likely consist of diverting Porcupine Creek around the tract and diverting its ephemeral tributaries or containing them in flood control reservoirs.

Due to its location in the headwater area of ephemeral Antelope Creek tributaries, and due to the fact that much of the tract drains internally to a closed basin, runoff within the NARO South LBA Tract would not be expected to be significant. During mining, hydrologic control would most likely consist of allowing runoff to accrue to the mine pit, or to flood control reservoirs, where it would be treated and discharged according to the standards of WDEQ/WQD.

Little Thunder LBA Tract

The Little Thunder LBA Tract may encounter significant runoff in Little Thunder Creek and North Prong Little Thunder Creek. As such, hydrologic control during mining would most likely consist of containing these ephemeral draws in flood control reservoirs or diverting flows around active pits.

West Roundup LBA Tract

The West Roundup LBA Tract is located near the headwaters of Trussler Creek and Olson Draw, and runoff within the tract would not be expected to be significant. Hydrologic control during mining would most likely consist of containing these ephemeral draws in flood control reservoirs, diverting flows around active pits, or allowing runoff to accrue to the mine pit, where it would be treated and discharged according to the standards of WDEQ/WQD.

West Antelope LBA Tract

The West Antelope LBA Tract may encounter significant runoff in Spring Creek and Antelope Creek. According to ACC's West Antelope LBA Tract Lease Application (ACC 2000), ACC

would not plan to disturb Antelope Creek and buffer zone adjacent to Antelope Creek during mining, but would plan to divert a portion of Spring Creek around the open pit area if they acquire the tract.

Groundwater

Surface coal mining impacts the groundwater resource quantity in two ways: 1) the coal aquifers and any overburden aquifers are removed and replaced with unconsolidated backfill and 2) water levels in the coal and overburden aquifers adjacent to the mines are depressed as a result of seepage and dewatering into the open pits in the area of coal and overburden removal. If the NARO North, NARO South, Little Thunder, West Roundup, and West Antelope LBA Tracts are leased, the area of coal removal and reclamation would increase, and the area of impacts to groundwater quantity would increase. The area subject to lower water levels would be increased roughly in proportion to the increase in area affected by mining.

Mining each of the LBA tracts would remove shallow aquifers and replace the separate aquifer units with backfill composed of an unlayered mixture of the shale, siltstone, and sand that makes up the existing Wasatch Formation overburden and Fort Union Formation interburden. Impacts to the local groundwater systems resulting from mining each of the tracts would include completely dewatering the coal, overburden, and interburden within the area of coal removal, and enlarging the area of drawdown caused by coal and overburden removal. The extent that drawdowns propagate away from the mine pits is a function of the water-bearing properties of the aquifer materials. In materials with high transmissivity and low storativity, drawdowns extend further from the pit face than in materials with lower transmissivity and higher storage. In general, due to the geologic makeup of the Wasatch Formation overburden (discontinuous lenticular sandstones in a matrix of siltstone and shale), overburden drawdowns do not extend great distances from the active mine pits (Hydro-Engineering 1997, 1998, 1999, 2000). Because of the regional continuity and higher transmissivity within the Wyodak coal seam, drawdowns propagate much further in the coal aquifer than in the overburden. Drawdowns in the coal seam are a function of distance from the pit as well as geologic and hydrologic barriers and boundaries such as crop lines, fracture zones, and recharge sources.

Some private permitted water wells will be impacted (either directly by removal of the well or indirectly by water level drawdown) by approved mining operations occurring at the applicant and adjacent mines and additional water wells would be likely to be affected if the LBA tracts are leased. In compliance with SMCRA and Wyoming regulations, mine operators are required to provide the owner of a water right whose water source is interrupted, discontinued, or diminished by mining with water of equivalent quantity and quality; this mitigation is thus part of the action alternatives. The most probable source of replacement water would be one of the aquifers underlying the coal. The subcoal Fort Union aquifers

are not removed or disturbed by coal mining, so they are not directly impacted by coal mining activity.

As part of the permitting process, the mine operator would be required to update the list of potentially impacted wells and predict impacts to these and other water-supply wells within the five-ft drawdown contour. The operator would be required to commit to replacing these water supplies with water of equivalent quality and quantity if they are affected by mining.

The hydraulic properties of the backfill aquifer reported in the adjacent mines' permit documents are comparable to the Wasatch Formation overburden and Wyodak coal. The data available indicate that the hydraulic conductivity of the backfill would be greater than or equal to premining coal values, suggesting that wells completed in the backfill would provide yields greater than or equal to premining coal wells.

Mining and reclamation also impacts groundwater quality; the TDS concentration in the water resaturating the backfill is generally higher than the TDS concentration in the groundwater before mining. This is due to the exposure of fresh overburden surfaces to groundwater that moves through the backfill. Research conducted by the Montana Bureau of Mines and Geology on the coal fields of the northern PRB (Van Voast and Reiten 1988) indicates that upon initial saturation, mine backfill is generally high in TDS and contains soluble salts of calcium, magnesium and sodium sulfates. As the backfill is resaturated, the soluble salts are leached by groundwater inflow and TDS concentrations tend to decrease with time, indicating that the long term groundwater quality in mined and off-site lands would not be compromised (Van Voast and Reiten 1988).

Using data compiled from ten surface coal mines in the eastern PRB, Martin et al. (1988) concluded that backfill groundwater quality improves markedly after the backfill is leached with one pore volume of water. The same conclusions were reached by Van Voast and Reiten (1988) after analyzing data from the Decker and Colstrip Mine areas in the northern PRB. Postmining groundwaters are therefore expected to be of better quality after one pore volume of water moves through the backfill than what is observed in the backfill today. In general, the mine backfill groundwater TDS can be expected to range from 3,000 - 6,000 mg/L, similar to the premining Wasatch Formation aquifer, and meet Wyoming Class III standards for use as stock water.

Direct and indirect impacts to the groundwater system resulting from mining the five LBA tracts included in this analysis would add to the cumulative impacts that will occur due to mining existing leases. These impacts are discussed in Section 4.5.5. The probable groundwater impacts from the leasing and subsequent mining of each of the LBA tracts under the Proposed Action or Alternative 2 or 3 are described in the following paragraphs.

NARO North and South LBA Tracts

Mining the NARO North and NARO South LBA tracts would remove shallow aquifers on an additional 5,590 acres (Proposed Action configuration for NARO North and NARO South), 6,275 acres (Proposed Action configuration for NARO North and Alternative 2 configuration for NARO South), or 4,863 acres (Proposed Action configuration for NARO North and Alternative 3 configuration for NARO South) and replace the separate aquifer units with backfill composed of an unlayered mixture of the existing Wasatch Formation overburden and Fort Union Formation interburden.

Overburden monitor wells for the existing North Antelope/Rochelle Complex that were farther than 3,000 ft from the active pits recorded less than seven ft of drawdown from 1980 to 1999. No substantial water level changes were observed from 1999 to 2000 in 15 overburden wells monitored by the North Antelope/Rochelle Complex (Hydro-Engineering 2000). Monitoring of the existing mining operations has indicated that water level drawdowns have propagated much farther in the Wyodak coal seam aquifer than in the overburden. Coal drawdowns from 1980 to 1995 were generally in excess of five ft within four miles of the active pits at the North Antelope/Rochelle Complex (Hydro-Engineering 1996a). In 1999, PRCC monitored water levels in 37 monitor wells completed in the Wyodak coal seam and the maximum drawdown measured at that time was approximately 115 ft in a well located roughly 1,600 ft west of the active pit (Hydro-Engineering 2000). The maximum drawdown measured in 2001 was 123 ft at a well located less than 500 ft west of the active pit (PRCC 2001). The extent and magnitude of drawdown in the coal seam aquifer have been greatest in the areas west and north of the mine. Drawdowns recorded in monitor wells located within one mile west of the active pit are generally between 50 to 100 ft. Water levels and maps showing drawdowns in the vicinity of the pit are included in the annual report for the North Antelope/Rochelle Complex which is sent to WDEQ/LQD each year.

PRCC used the MODFLOW model to predict the extent of water level drawdown in the Wyodak coal seam as a result of mining the existing leases at North Antelope/Rochelle Complex. The results of the groundwater modeling are reported in Appendix D6, Addendum D6-G of the North Antelope/Rochelle Complex 569-T5 permit document (PRCC 1999b). The predicted extent of drawdown (five ft contour) over the life of the mine if the NARO North and NARO South LBA Tracts are mined is shown on Figure 4-9. This prediction is approximate and based on extrapolation of PRCC's earlier predictions by extending the drawdowns westward and northward by the dimensions of the NARO North and South LBA Tracts. More precise predictions of the extent of drawdowns would be required in order to amend the NARO North and South LBA Tracts into the WDEQ/LQD permit area, if PRCC acquires the tracts.

Figure 4-9

In November 2001, the Wyoming SEO records indicated a total of 539 permitted water wells are located within three miles of the NARO North LBA Tract and 615 permitted water wells are located within three miles of the NARO South LBA Tract. The majority (956) are owned by coal mining companies and are used for groundwater monitoring and water supply. The other 198 non mine-related wells are apportioned into the following use categories:

- 65 Monitoring and miscellaneous
- 64 livestock
- 32 livestock and CBM development
- 12 livestock and domestic
- 11 miscellaneous
- 4 industrial
- 4 CBM development
- 3 livestock, miscellaneous and CBM development
- 2 livestock and miscellaneous
- 1 livestock and irrigation

Three of these permitted water wells are located within the expanded five-ft drawdown contour with completion depths that indicate they produce water from the Wyodak coal seam (this excludes wells constructed for monitoring, mine dewatering or CBM production). These wells are shown in Table 4-7. During the permitting process, the mine operator would be required to update the list of potentially impacted wells and predict impacts to these and other water-supply wells within the five-ft drawdown contour. The operator would be required to commit to replacing these water supplies with water of equivalent quality and quantity if they are affected by mining.

PRCC has three water supply wells completed in aquifers below the coal. If the LBA tracts are leased by the applicant, water would be produced from these wells for a longer period of time, but PRCC would not require additional sub-coal wells to mine the LBA tracts.

Groundwater quality within the backfill aquifer at the NARO North

Table 4-7. Water Supply Wells Possibly Subject to Drawdown if NARO North and South LBA Tracts are Mined.

SEO Permit Number	Applicant	Use	Yield (gpm)	Well Depth (ft)	Depth to Water (ft)
P25606P	Paul & Edith Ruth Wilkinson	Stock, Domestic	3	220	100
P12754P	USFS	Stock	4	122	unknown
P44330W	USFS	Stock	3	163	94

Note: Wells in this table are believed from their completion depths to be completed in the Wyodak coal seam, and are within the additional area of five ft or more drawdown caused by mining the NARO North and South LBA Tracts. Wells impacted by the No Action Alternative are already addressed in the state mine permit document.

and South LBA Tracts would be expected to be similar to groundwater quality measured in existing wells completed in the backfill at North Antelope/Rochelle Complex. To date, nine wells have been installed to monitor water levels and water quality in backfill at the North Antelope/Rochelle Complex. In October 1999, TDS concentrations in the nine monitoring wells ranged from 780 to 14,200 mg/L (Hydro-Engineering 2000) with a geometric mean of 3,070 mg/L. TDS concentrations observed in the North Antelope/Rochelle Complex backfill are generally higher than those found in the undisturbed Wasatch Formation overburden or Wyodak coal aquifers.

The hydraulic properties of the backfill aquifer at the NARO North and South LBA Tracts would be expected to be similar to the hydraulic properties measured in existing wells completed in the backfill at North Antelope/Rochelle Complex. The backfill aquifer has been tested at four wells, and the average hydraulic conductivity of 36 ft/day exceeds the average hydraulic conductivity (9.5 ft/day) reported for the Wyodak coal seam in the vicinity of the North Antelope/Rochelle Complex.

Little Thunder LBA Tract

Mining the LBA tract would remove shallow aquifers on an additional 5,424 acres (Proposed Action configuration), 6,577 acres (Alternative 2 configuration), 1,382 acres (Alternative 3, North tract configuration) or 4,018 acres (Alternative 3, South tract configuration) and replace the separate aquifer units with backfill composed of an unlayered mixture of the existing Wasatch Formation overburden and Fort Union Formation interburden.

Overburden water levels have been monitored and recorded by Black Thunder Mine since 1980 at eleven monitor wells (Hydro-Engineering 2000). Data recorded during that period do not indicate mining has necessarily caused water levels in the overburden to be depressed in proportion to distance and direction from the active pits or in time since mining began. The maximum drawdown measured to date in the overburden is approximately 39 ft at a monitor well located about 0.5 miles west of the active pit. Impacts to overburden water levels recorded to date by other monitor wells located within 1.5 miles of the pit have ranged from a decrease of 19 ft to an increase of 30 ft, with some areas basically unchanged. Because of the varied nature of the aquifer units within the Wasatch Formation overburden, water level drawdowns are variable as well.

Water level drawdowns have propagated much farther and in a more consistent manner in the Wyodak coal seam aquifer than in the overburden. Coal drawdowns from 1980 to 1995 were generally in excess of five ft within five miles west and one mile north of the active pit at the Black Thunder Mine (Hydro-Engineering 1996a). Since 1995, coal monitor wells located over two miles west of the active pits recorded an increased rate of drawdown as a result of dewatering associated with

CBM production. Coal water levels recorded by monitor wells located between two and 4.5 miles west of the pit declined between 21 and 67 ft from 1995 to 1999. During that same time period, coal water levels less than two miles west of the active Black Thunder Mine pits declined between 10 and 28 ft. In 1999, TBCC monitored water levels in 10 monitor wells completed in the Wyodak coal seam and the maximum drawdown measured at that time was approximately 80 ft in a well located roughly three miles west the active pit (Hydro-Engineering 2000). Coal monitor wells within 0.5 mile west of the pit have recorded an overall decline of about 60 ft. Water levels and maps showing drawdowns in the vicinity of the pit are included in the annual report that the Black Thunder Mine submits to WDEQ/LQD each year.

TBCC used the MODFLOW model to predict the extent of water level drawdown in the Wyodak coal seam as a result of mining the existing leases at Black Thunder Mine. The results of the groundwater modeling which was updated in July 1999 to predict impacts associated with the development of the Thundercloud Amendment Area, are presented in Addendum MP-3.3.4 of the Black Thunder Mine 233-T6 permit document (TBCC 2000a). The predicted extent of drawdown (five ft contour) over the life of the mine if the Little Thunder LBA Tract is mined is shown on Figure 4-10. This prediction is approximate and based on extrapolation of TBCC's earlier predictions by extending the drawdowns westward and northward by the dimensions of the Little Thunder LBA Tract. More precise predictions of the extent of drawdowns would be required in order to amend the Little Thunder LBA Tract into the WDEQ/LQD permit area, if ALC acquires the tract.

In November 2001, the Wyoming SEO records indicated a total of 634 permitted water wells are located within three miles of the Little Thunder LBA Tract. Of this total, 182 are owned by coal mining companies and are used for groundwater monitoring and water supply. The other 451 non mine-related wells are apportioned into the following use categories:

- 233 CBM development only
- 116 CBM development and livestock
- 38 monitoring and miscellaneous
- 37 livestock only
- 10 livestock and domestic
- 5 CBM development and miscellaneous
- 5 monitoring, livestock and miscellaneous
- 3 livestock, industrial and miscellaneous
- 2 reservoir supply and miscellaneous
- 2 CBM development, livestock and miscellaneous

Two of these permitted water wells are located within the expanded five-ft drawdown contour with completion depths that indicate they produce water from the Wyodak coal seam (this excludes wells constructed for monitoring, mine dewatering or CBM production). These wells are shown in Table 4-8. During the permitting process, the mine operator would be

Figure 4-10

required to update the list of potentially impacted wells and predict impacts to these and other water-supply wells within the five-ft drawdown contour. The operator would be required to commit to replacing these water supplies with water of equivalent quality and quantity if they are affected by mining.

TBCC has two water supply wells completed in aquifers below the coal. If the LBA tract is lease by the applicant, water would be produced from these wells for a longer period of time, but TBCC would not require additional sub-coal wells to mine the LBA tract.

Groundwater quality within the backfill aquifer at the Little Thunder LBA Tract would be expected to be similar to groundwater quality measured in existing wells completed in the backfill at Black Thunder Mine. To date, six wells have been installed to monitor water levels and water quality in the backfill at Black Thunder Mine. In October 1999, TDS concentrations in five of the backfill monitoring wells (one well can not be sampled due to a lack of saturation) ranged from 1,090 to 5,440 mg/L (Hydro-Engineering 2000) with a geometric mean of 2,140 mg/L. TDS concentrations observed in the Black Thunder Mine backfill are generally higher than those found in the undisturbed Wasatch Formation overburden or Wyodak coal aquifers.

The hydraulic properties of the backfill aquifer at the Little Thunder LBA Tract would be expected to be similar to the hydraulic properties measured in existing wells completed in the backfill at Black Thunder Mine. The hydraulic conductivities of 0.12 ft/day and 0.86 ft/day determined by testing two of the backfill wells are lower than the hydraulic conductivity (1.2 ft/day) reported for the Wyodak coal seam within the Little Thunder LBA Tract.

West Roundup LBA Tract

Mining the LBA tract would remove shallow aquifers on an additional 3,161 acres (Proposed Action configuration), 3,787 acres (Alternative 2 configuration), 3,943 acres (Alternative 2 plus lease WYW-

Table 4-8. Water Supply Wells Possibly Subject to Drawdown if Little Thunder LBA Tract is Mined.

SEO Permit Number	Applicant	Use	Yield (gpm)	Well Depth (ft)	Depth to Water (ft)
P13289P	Durham Meat Co.	Stock	unknown	108	66
P92738W	James R. & Irene Stuart	Stock	unknown	100	40

Note: Wells in this table are believed from their completion depths to be completed in the Wyodak coal seam, and are within the additional area of five ft or more drawdown caused by mining the Little Thunder LBA Tract. Wells impacted by the No Action Alternative are already addressed in the state mine permit document.

127221 modification configuration), 4,184 acres (Alternative 3 configuration), or 4,340 acres (Alternative 3 plus lease WYW-127221 modification configuration), and replace the separate aquifer units with backfill composed of an unlayered mixture of the existing Wasatch Formation overburden and Fort Union Formation interburden.

Overburden water levels have been monitored and recorded by North Rochelle Mine since 1981 at five monitor wells (Hydro-Engineering 2000). Data recorded during that period do not indicate mining has necessarily caused water levels in the overburden to be depressed in proportion to distance and direction unknown from the active pits or in time since mining began. The maximum drawdown measured to date in the overburden is approximately 14 ft at a monitor well located nearly one mile east of the active pit. Another overburden monitor well located approximately 1,500 ft west of the active pit has recorded an overall drawdown of 10 ft, 4.5 ft of that decline occurred from 1998 to 1999 (Hydro-Engineering 2000). No substantial water level changes were observed during 1998 to 1999 at the other three overburden wells monitored by TCC. Because of the varied nature of the aquifer units within the Wasatch Formation overburden, water level drawdowns are variable as well.

Water level drawdowns have propagated much farther and in a more consistent manner in the Wyodak coal seam aquifer than in the overburden. Coal drawdowns from 1980 to 1995 were generally in excess of 20 ft within one mile of the active pit at North Rochelle Mine (Hydro-Engineering 1996a). TCC monitored water levels at five wells completed in the coal from 1980 to 1995. The mining operation then removed two coal wells, leaving three coal monitoring wells from 1995 to 1998. In 1999, TCC monitored and recorded water levels in two Wyodak coal wells after a third was removed by mining. From 1998 to 1999, the two remaining coal monitor wells recorded drawdowns of 8.08 and 29.99 ft and both wells are located approximately a half-mile west of the active pit (Hydro-Engineering 2000). Water levels and maps showing drawdowns in the vicinity of the pit are included in the annual report filed by the North Rochelle Mine with WDEQ/LQD each year.

TCC used the MODFLOW model to predict the extent of water level drawdown in the Wyodak coal seam as a result of mining the existing leases at North Rochelle Mine. The results of the groundwater modeling, which was updated in January 2000 to predict impacts associated with the development of the North Roundup Amendment, are presented in Addendum MP-E of the North Rochelle Mine 550-T5 permit document (TCC 2000a). The predicted extent of drawdown (five ft contour) over the life of the mine if the West Roundup LBA Tract is mined is shown on Figure 4-11. This prediction is approximate and based on extrapolation of TCC's earlier predictions by extending the drawdowns westward and northward by the dimensions of the West Roundup LBA Tract. More precise predictions of the extent of

Figure 4-11

drawdowns would be required in order to amend the West Roundup LBA Tract into the WDEQ/LQD permit area, if the North Rochelle Mine acquires the West Roundup LBA Tract.

In November 2001, the Wyoming SEO records indicated a total of 441 permitted water wells are located within three miles of the West Roundup LBA Tract. Of this total, 221 are owned by coal mining companies and are used for groundwater monitoring and water supply. The other 220 non mine-related wells are apportioned into the following use categories:

- 90 CBM development only
- 50 monitoring and miscellaneous
- 38 livestock only
- 27 CBM development and livestock
- 5 monitoring, livestock and miscellaneous
- 8 monitoring only
- 3 industrial
- 2 domestic and livestock
- 2 CBM development, livestock and miscellaneous

Six of these permitted water wells are located within the expanded five-ft drawdown contour with completion depths that indicate they produce water from the Wyodak coal seam (this excludes wells constructed for monitoring, mine dewatering or CBM production). These wells are shown on Table 4-9. During the permitting process, the mine operator would be required to update the list of potentially impacted wells and predict impacts to these and other water-supply wells within the five-ft drawdown contour. The operator would be required to commit to replacing these water supplies with water of equivalent quality and quantity if they are affected by mining.

TCC has two water supply wells completed in aquifers below the coal. If the LBA tract is lease by the applicant, water would be produced from these wells for a longer period of time, but TCC would not require additional sub-coal wells to mine the LBA tract.

Groundwater quality within the backfill aquifer at the West Roundup LBA Tract would be expected to be similar to groundwater quality measured in existing wells completed in the backfill at nearby mines. Due to the absence of saturated backfill at North Rochelle Mine, no site-specific data are available yet for the quality of groundwater within the mine's backfill. TDS concentrations observed in the backfill at nearby mines are generally higher than those found in the undisturbed Wasatch Formation overburden or Wyodak coal aquifer. At the Black Thunder Mine, which is located north of and adjacent to the North Rochelle Mine, October 1999 TDS concentrations of groundwater from the backfill were varied and ranged from 1,090 to 5,440 mg/L (Hydro-Engineering 2000) with a geometric mean of 2,140 mg/L.

The hydraulic properties of the backfill aquifer at the West Roundup LBA Tract would be expected to be similar to the hydraulic properties measured in existing wells completed in the backfill at nearby mines.

Table 4-9. Water Supply Wells Possibly Subject to Drawdown if West Roundup LBA Tract is Mined.

SEO Permit Number	Applicant	Use	Yield (gpm)	Well Depth (ft)	Depth to Water (ft)
P12757P	USFS	Stock	4	165	unknown
P101801W	Bridle Bit Ranch Company	Stock	20	264	80
P25608P	Paul & Edith Ruth Wilkinson	Stock	4	110	flowing
P5848W	Paul Wilkinson	Stock	3	140	0
P29746W	USFS	Stock	10	175	30
P25120W	Atlantic Richfield Company	Monitoring, Miscellaneous	0	142	97

Note: Wells in this table are believed from their completion depths to be completed in the Wyodak coal seam, and are within the additional area of five ft or more drawdown caused by mining the West Roundup Tract. Wells impacted by the No Action Alternative are already addressed in the state mine permit document.

Again, due to the minimal areal extent of backfill and consequently a lack of saturation at North Rochelle Mine to date, no site-specific data are available for the hydraulic properties of the mine's backfill. At Black Thunder Mine, the backfill has been tested at two wells, and the hydraulic conductivities of 0.12 ft/day and 0.86 ft/day are slightly lower than the hydraulic conductivity (1.2 ft/day) reported for the Wyodak coal seam within the nearby Little Thunder LBA Tract.

West Antelope LBA Tract

Mining the LBA tract would remove shallow aquifers on an additional 3,200 acres (Proposed Action configuration), 3,500 acres (Alternative 2 configuration), or 2,467 acres (Alternative 3 configuration and replace the separate aquifer units with backfill composed of an unlayered mixture of the existing Wasatch Formation overburden and Fort Union Formation interburden.

Of the three overburden wells that are currently monitored by ACC, no substantial water level declines were observed from 1979 to 2001 (ACC 2001). One of the three overburden monitor wells exhibited a water level decline of approximately six ft in 1999, probably due to an active pit encroaching to within 0.5 mile of the well. Of the three interburden wells that are currently monitored by ACC, one well has exhibited about six ft of overall drawdown, one well has recorded no drawdown, and the other well has recorded roughly a two ft increase in water level from 1979 to 2001 (ACC 2001). Two underburden wells are currently being monitored and have recorded between 35 and 40 ft of drawdown. Decreases in water levels in underburden monitoring wells are thought by ACC to be caused by depressurization

associated with dewatering of the overlying coal seams.

Water level drawdowns have propagated much farther in the Wyodak/Anderson and Canyon coal seam aquifer than in the overburden. Coal drawdowns from 1980 to 1995 were generally in excess of five ft within four miles of the active pits at the Antelope Mine (Hydro-Engineering 1996a). In 2000 and 2001, ACC monitored water levels in 12 monitor wells completed in the Anderson coal seam and nine monitor wells in the Canyon coal seam. The maximum drawdown measured at that time in an Anderson monitor well was about 32 ft. That well is located approximately 3,500 ft northwest of the active pit. The maximum drawdown measured to date in the Canyon coal seam is about 100 ft. at a monitor well located within 1,000 ft of the active pit (ACC 2001). Prior to 1993, mining occurred in relatively dry portions of the Anderson coal seam and little to no drawdown occurred within that aquifer. The water level in the Canyon coal seam has shown a drawdown trend in most monitor wells starting in 1988, apparently due to mining activities to the north of the Antelope Mine. The downward trend has accelerated from 1988 to the present as a result of mining a fully saturated Canyon coal seam in the northeastern part of the Antelope Mine. Those Canyon coal monitor wells within 0.5 mile north and west of the active pits have recorded an overall decline of about 80 to 90 ft. Drawdowns in both seams have resulted not only from mining, but also from a series of dewatering wells that have been used to lower water levels in advance of the pit since 1993. Water levels and maps showing drawdowns in the vicinity of the pit are included in the annual report for the Antelope Mine filed by ACC with WDEQ/LQD each year.

ACC used the MODFLOW model to predict the extent of water level drawdown in the Anderson and Canyon coal seam aquifers as a result of mining the existing leases at Antelope Mine. The results of the groundwater modeling are reported in the Mine Plan, Section MP5, Addendum MP-C of the Antelope Mine 525-T6 permit document (ACC 1998). The predicted extent of drawdown (five ft contour) in the Anderson-Canyon coal seam over the life of the mine if the Antelope Mine acquires the West Antelope LBA Tract is shown on Figure 4-12. This prediction is approximate and is based on extrapolation of ACC's earlier predictions by extending the drawdowns westward and northward by the dimensions of the West Antelope LBA Tract. More precise predictions of the extent of drawdowns would be required in order to amend the West Antelope LBA Tract into the WDEQ/LQD permit area, if the Antelope Mine acquires the West Antelope LBA Tract.

In November 2001, the Wyoming SEO records indicated a total of 276 permitted water wells are located within three miles of the West Antelope LBA Tract. The majority (198) are owned by coal mining companies and are used for groundwater monitoring, dewatering and water supply. The other 78 non

Figure 4-12

mine-related wells are apportioned into the following use categories:

- 33 livestock
- 16 livestock and CBM development
- 10 monitoring or miscellaneous
- 8 livestock or domestic
- 5 CBM development
- 2 livestock and miscellaneous
- 1 livestock and reservoir
- 1 industrial
- 1 livestock, miscellaneous and CBM development
- 1 domestic

Six of these permitted water wells are located within the expanded five-ft drawdown contour with completion depths that indicate they produce water from the Anderson or Canyon coal seam (this excludes wells constructed for monitoring, mine dewatering or CBM production). These wells are shown on Table 4-10.

During the permitting process, the mine operator would be required to update the list of potentially impacted wells and predict impacts to these and other water-supply wells within the five-ft drawdown contour. The operator would be required to commit to replacing these water supplies with water of equivalent quality and quantity if they are affected by mining.

ACC has one water supply well completed in aquifers below the coal. If the LBA tract is lease by the applicant, water would be produced from this well for a longer period of time, but ACC would not require additional sub-coal wells to mine the LBA tract.

Groundwater quality within the backfill aquifer at the West Antelope LBA Tract would be expected to be similar to groundwater quality measured in existing wells completed in the backfill at Antelope Mine. To date, seven wells have been installed to monitor water levels and water quality in backfill at the Antelope Mine. Four of these backfill monitoring wells are located in the southern part of the mine and have not yet been sampled due to a lack of saturation. Three backfill monitoring wells that were added to ACC's monitoring program in 2000 are located in the northeastern part of the mine and had sufficient saturation to be sampled in 2001. TDS concentrations in these three monitoring wells ranged from 1,990 to 5,120 mg/L in August 2001 (ACC 2001).

The hydraulic properties of the backfill aquifer at the West Antelope LBA Tract would be expected to be similar to the hydraulic properties measured in existing wells completed in the backfill at nearby mines. To date, no site-specific data are available for the hydraulic properties of the mine's backfill. The hydraulic properties measured in existing wells completed in the backfill at North Antelope/Rochelle Complex, located northeast of the Antelope Mine, are variable but in general comparable to the Wasatch Formation overburden and Wyodak coal. At North Antelope/Rochelle Complex, the backfill aquifer has been tested at four wells, and the average hydraulic conductivity is 36 ft/day, which exceeds the average hydraulic conductivity (9.5 ft/day) reported for the Wyodak coal seam in the vicinity

Table 4-10. Water Supply Wells Possibly Subject to Drawdown if West Antelope LBA Tract is Mined.

SEO Permit Number	Applicant	Use	Yield (gpm)	Well Depth (ft)	Depth to Water (ft)
P23600P	Patricia L. Isenberger	Stock	7	300	100
P50638W	Patricia L. Isenberger	Stock	15	210	35
P76179W	WY State Highway Dept.	Monitoring, Miscellaneous	0	300	33
P109953W	Patricia L. Isenberger Litton	Miscellaneous	1	350	60
P5612P	Patricia L. Isenberger Litton	Stock	1	350	60
P23601P	Patricia L. Isenberger	Stock	7	250	unknown

Note: Wells in this table are believed from their completion depths to be completed in the Canyon or Anderson coal seam, and are within the additional area of five ft or more drawdown caused by mining the West Antelope Tract. Wells impacted by the No Action Alternative are already addressed in the state mine permit document.

of the North Antelope/Rochelle Complex. The data available indicate that the hydraulic conductivity of the backfill would be greater than or equal to premining coal values, suggesting that wells completed in the backfill would provide yields greater than or equal to premining coal wells.

4.1.6 Alluvial Valley Floors

Impacts to designated AVFs are generally not permitted if the AVF is determined to be significant to agriculture. AVFs that are not significant to agriculture can be disturbed during mining, but they must be restored as part of the reclamation process. In order to restore the AVF, the physical and hydrologic characteristics of the AVF must be determined. AVF investigations conducted within the General Analysis Area have identified AVFs that occur along Porcupine Creek, Antelope Creek, Little Thunder Creek, and North Prong Little Thunder Creek downstream of the LBA tracts. Within the General Analysis Area, one flood irrigated hay meadow near the confluence of Porcupine Creek and Antelope Creek has been determined by the WDEQ/LQD to be significant to agriculture.

The NARO North and Little Thunder LBA Tracts, have been evaluated and declared non-AVF by WDEQ/LQD. The NARO South LBA Tract, West Roundup LBA Tract and portions of the West Antelope LBA Tract have not yet been formally evaluated for the presence of AVFs.

No unconsolidated stream laid deposits are found within the NARO South LBA Tract; therefore, it is unlikely an AVF declaration would be made.

Based on previous non-AVF declarations made on Olson Draw

downstream of the West Roundup LBA Tract, it is unlikely that this channel would receive an AVF declaration upstream on the LBA tract where the drainage is smaller and AVF characteristics are negligible.

Antelope Creek within and extending two miles upstream from the existing Antelope Mine permit boundary has been declared an AVF by WDEQ/LQD, and a portion of this declared AVF is within the West Antelope LBA Tract. ACC's approved mining and reclamation plan avoids disturbing Antelope Creek and an adjacent designated buffer zone. Therefore, portions of the Antelope Creek valley within the West Antelope LBA Tract would not be mined, if the Antelope Mine acquires the tract.

Spring Creek within and extending two miles upstream from the existing Antelope Mine permit boundary has also been investigated for the presence of an AVF by ACC, although no specific declarations have been made by the WDEQ/LQD. If ACC acquires the West Antelope LBA Tract, those portions of the tract and surrounding area that would be amended into the Antelope Mine permit that have not had specific declarations of the presence or absence of AVFs would be investigated as part of the mine permitting process. The WDEQ/LQD has determined that the declared and potential AVFs within the current Antelope Mine permit boundary are not significant to agriculture (ACC, State Decision Document 2001). With the exception of an unsuccessful attempt at flood irrigation on Spring Creek, there is no present or historical record of agricultural use, other than undeveloped rangeland, of the stream laid deposits within the West Antelope LBA Tract. If WDEQ determines that an AVF is present on the tract, it is reasonable to assume that mining would be permitted in those areas because the lack of agricultural development in this area precludes a determination of significance to agriculture.

Streamflows in Spring Creek would be diverted around the active mining areas in a temporary diversion channel. Consequently, disruptions to streamflows that might supply AVFs on Antelope Creek downstream of the Antelope Mine would not be expected to be substantial.

Streamflows in the other LBA tracts would be diverted around the active mining areas in temporary diversion ditches or captured in flood control reservoirs above the pit. If flood control impoundments are used, it would be necessary to evacuate them following major runoff events to provide storage volume for the next flood. Consequently, disruptions to streamflows that might supply downstream AVFs are expected to be negligible. Groundwater intercepted by the mine pits would be routed through settling ponds to meet state and federal quality criteria, and the pond discharges would likely increase the frequency and amount of flow in these streams, thereby increasing surface water supplies to downstream AVFs.

If the LBA tracts are mined as extensions of existing operations, the mining would extend upstream on streams already in active mine areas.

Therefore, no direct, indirect, or cumulative impacts are anticipated to off-site AVFs through mining of any of the LBA tracts included in this analysis.

4.1.7 Wetlands

PRCC, TBCC, TCC, and ACC have completed wetland inventories identifying the acres of jurisdictional and non-jurisdictional wetlands on each of the LBA tracts as applied for and lands added under BLM alternative configurations. Table 4-11 presents the inventory results for each LBA tract. A maximum of 62.16 acres of jurisdictional and 51.58 acres of non-jurisdictional wetlands would be disturbed if each of the LBA tracts is leased and subsequently mined under the largest action alternative configuration.

Most existing wetlands on the LBA tracts would be destroyed by currently approved mining operations at the adjacent mines. The exception may be riverine wetlands associated with Antelope Creek and wetlands association with other streams that cross the LBA tracts but would not be disturbed during currently approved mining operations. COE requires replacement of all impacted jurisdictional wetlands in accordance with Section 404 of the Clean Water Act. Replacement of functional wetlands on privately-owned surface may occur in accordance with agreements with the private landowners; privately owned surface lands are included in all five LBA tracts as applied for. During the period of time after mining and before replacement of wetlands, all wetland functions would be lost. The replaced wetlands may not duplicate the exact function and landscape features of the premine wetlands, but replacement plans would be evaluated by COE and replacement would be in accordance with the requirements of Section 404 of the Clean Water Act as determined by COE.

Table 4-11. Maximum Wetland Impacts in the NARO North and South, Little Thunder, West Roundup, and West Antelope LBA Tracts.

LBA Tract	Jurisdictional Wetlands[1] (acres)	Non-Jurisdictional Wetlands[1] (acres)
NARO North and South	18.40	28.50
Little Thunder	5.19	2.87
West Roundup	6.80	20.21
West Antelope	31.77	0.00
Total	**62.16**	**51.58**

Notes: [1] Includes the area of each LBA tract as applied for, lands added under BLM alternatives, and the additional area that would be disturbed by mining and reclaiming the tract as part of the existing mining operation.

As a result of recent court directives, playas may no longer be identified as jurisdictional waters of the U.S. under Section 404 of the Clean Water Act. These non-jurisdictional wetland features, having significant biological and hydrological features, cover portions of the NARO North and South, Little Thunder, and West Roundup LBA Tracts. Although COE may not require their replacement as a result of the recent court directive, the applicant mines plan to continue establishing playa/depression features within the reclaimed topography if the LBA tracts are mined as extensions of existing operations. If no special segregation and placement of overburden and soils are necessary, reclamation costs do not increase if playa/depressional features are restored. However, if special handling of materials is necessary, the reclamation costs associated with restoration of playa/depressional features are generally higher on a site-specific basis.

4.1.8 Vegetation

Under the Proposed Actions, mining of the five LBA tracts would progressively remove the native vegetation on 17,375 acres on and near the LBA tracts. Vegetation removal at each LBA tract under the Proposed Actions and action alternatives is presented as the additional disturbance areas in Tables 2-1 through 2-4.

Short-term impacts associated with the removal of vegetation from the LBA tracts would include increased soil erosion and habitat loss for wildlife and livestock. Potential long-term impacts include loss of habitat for some wildlife species as a result of reduced plant species diversity, particularly big sagebrush, on reclaimed lands. However, grassland-dependent wildlife species and livestock would benefit from the increased grass cover and production.

Reclamation, including revegetation of these lands, would occur contemporaneously with mining on adjacent lands, i.e., reclamation would begin once an area is mined. Estimates of the time elapsed from topsoil stripping through reseeding of any given area range from two to four years. This would be longer for areas occupied by stockpiles, haulroads, sediment-control structures, and other mine facilities. Some roads and facilities would not be reclaimed until the end of mining. No new life-of-mine facilities would be located on any of the LBA tracts under the Proposed Actions or Alternatives 2 or 3, in which each LBA tract would be mined as an extension of an existing mine.

Grazing restrictions prior to mining and during reclamation would remove up to 100 percent of the LBA areas from livestock grazing. This reduction in vegetative production would not seriously affect livestock production in the region, and long-term productivity on the reclaimed land would return to premining levels within several years following seeding with the approved final seed mixture. Wildlife use of the area would not be significantly restricted throughout the operations.

Reestablished vegetation would be dominated by species mandated in

the reclamation seed mixtures (to be approved by WDEQ). The majority of the approved species are native to the LBA tracts. Initially, the reclaimed lands would be dominated by grassland vegetation, which would be less diverse than the premining vegetation. At least 20 percent of the area would be reclaimed to native shrubs at a density of one per square meter as required by current regulations. Estimates for the time it would take to restore shrubs to premining density levels range from 20 to 100 years. An indirect impact of this vegetative change could be decreased big game habitat carrying capacity. Following completion of reclamation (seeding with the final seed mixture) and before release of the reclamation bond (a minimum of ten years), a diverse, productive, and permanent vegetative cover would be established on the LBA tracts. The decrease in plant diversity would not seriously affect the potential productivity of the reclaimed areas, and the proposed postmining land use (wildlife habitat and rangeland) should be achieved even with the changes in vegetation composition and diversity. Private landowners (Figures 3-6 through 3-9) would have the right to manipulate the vegetation on their lands as they desire once the reclamation bond is released.

On average, approximately 3,600 to 4,000 acres would be disturbed each year that mining occurs if all five proposed lease areas are mined concurrently. This disturbance would occur regardless of which action alternatives are selected. By the time mining ceases, over 75 percent of these disturbed lands would have been reseeded. The remaining 25 percent would be reseeded during the following two to three years as the life-of-mine facilities areas are reclaimed.

The reclamation plans for the existing mines include steps to control invasion by weedy (invasive nonnative) plant species. The reclamation plans for each LBA tract would also include steps to control invasion from such species. Native vegetation from surrounding areas would gradually invade and become established on the reclaimed land.

The climatic record of the western U.S. suggests that droughts could occur periodically during the life of the mines. Such droughts would severely hamper revegetation efforts, since lack of sufficient moisture would reduce germination and could damage newly established plants. Same-aged vegetation would be more susceptible to disease than would plants of various ages. Severe thunderstorms could also adversely affect newly seeded areas. Once a stable vegetative cover is established, however, these events would have similar impacts as would occur on native vegetation.

Changes expected in the surface water network on each LBA tract as a result of mining and reclamation would affect the reestablishment of vegetation patterns on the reclaimed areas to some extent. The postmining maximum overland slope would be 20 percent in accordance with WDEQ policy. The average reclaimed overland slope on each LBA tract would not be known until WDEQ's technical review of each permit revision application is complete. No

significant changes in the average overland slope are predicted.

Following reclamation, the LBA tracts would be primarily a mixture of prairie grasslands with graminoid/forb-dominated areas. An overall reduction in species diversity, especially for the shrub component, would occur. As indicated previously, following reclamation bond release, management of the privately-owned surface areas would revert back to the private surface owners, who would have the right to manipulate the reclaimed vegetation.

Jurisdictional wetlands would fall under the jurisdiction of the COE. Detailed wetland mitigation plans would be developed at the permitting stage to ensure no net loss of jurisdictional wetlands within the General Analysis Area. Functional wetlands may be restored in accordance with the requirements of the surface landowner.

The decrease in plant diversity would not seriously affect productivity of the reclaimed areas, regardless of the alternatives selected, and the proposed postmining land use (wildlife habitat and rangeland) would be achieved even with the changes in vegetative species composition and diversity.

4.1.9 Threatened, Endangered, Proposed, and Candidate Plant Species and USFS Region 2 Sensitive Species

Refer to Appendix G.

4.1.10 Wildlife

Local wildlife populations are directly and indirectly impacted by mining. These impacts are both short-term (until successful reclamation is achieved) and long-term (persisting beyond successful completion of reclamation). The direct impacts of surface coal mining on wildlife occur during mining and are therefore short-term. They include road kills by mine-related traffic, restrictions on wildlife movement created by fences, spoil piles, and pits, and displacement of wildlife from active mining areas. Displaced animals may find equally suitable habitat that is not occupied by other animals, occupy suitable habitat that is already being used by other individuals, or occupy poorer quality habitat than that from which they were displaced. In the second and third situations, the animals may suffer from increased competition with other animals and are less likely to survive and reproduce. The indirect impacts are longer term and may included a reduction in big game carrying capacity and microhabitats on reclaimed land due to flatter topography, less diverse vegetative cover, and reduction in sagebrush density.

These impacts are currently occurring on the existing leases as mining occurs. If the LBA tracts are leased under the Proposed Actions or Alternatives 2 or 3, the areas of mining disturbance would extend onto the LBA tracts. Mining would be extended by up to 5.5 years at the North Antelope/Rochelle Complex, 10.7 years at the Black Thunder Mine, and 7.1 years at the North

Rochelle Mine. Mining of the West Antelope LBA Tract by ACC is not expected to extend the current mining life.

Under the Proposed Actions and action alternatives, big game would be displaced from portions of the LBA tracts to adjacent ranges during mining. Pronghorn would be most affected; however, none of the areas within two miles of the LBA tracts has been classified as crucial or critical pronghorn habitat. Mule deer would not be substantially impacted, given their infrequent use of these lands and the availability of suitable habitat in adjacent areas. None of the land within the General Analysis Area is considered by WGFD to be an elk use area, although elk have been observed wintering on reclaimed grasslands within the General Analysis Area in recent years. Big game displacement would be incremental, occurring over several years and allowing for gradual changes in distribution patterns. Big game residing in the adjacent areas could be impacted by increased competition with displaced animals. Noise, dust, and associated human presence would cause some localized avoidance of foraging areas adjacent to mining activities. On the existing leases, however, big game have continued to occupy areas adjacent to and within active mining operations, suggesting that some animals may become habituated to such disturbances.

Big game animals are highly mobile and can move to undisturbed areas. There would be more restrictions on big game movement on or through the tracts, however, due to the construction of additional fences, spoil piles, and pits related to mining. During winter storms, pronghorn may not be able to negotiate these barriers. WDEQ guidelines require fencing to be designed to permit pronghorn passage to the extent possible.

Recently, the WGFD reviewed monitoring data collected on mine sites for big game species and the monitoring requirements for big game species on those mine sites. Their findings concluded that the monitoring had demonstrated the lack of impacts to big game on existing mine sites. No severe mine-caused mortalities have occurred and no long-lasting impacts on big game have been noted on existing mine sites. The WGFD therefore recommended that big game monitoring be discontinued on all existing mine sites. New mines will be required to conduct big game monitoring if located in crucial winter range or in significant migration corridors, neither of which are present within the LBA tracts within the General Analysis Area.

If the LBA tracts are leased, road kills related to mine traffic would be extended within the General Analysis Area by up to 5.5 years for the North Antelope/Rochelle Complex, 10.7 years for Black Thunder Mine, and 7.1 years for North Rochelle Mine. The life of the Antelope Mine would not be extended if the West Antelope lease is mined.

After mining and reclamation, alterations in the topography and vegetative cover, particularly the reduction in sagebrush density,

would cause a decrease in carrying capacity and diversity on the LBA tracts. Sagebrush would gradually become reestablished on the reclaimed land, but the topographic changes would be permanent.

Medium-sized mammals (such as rabbits, coyotes, and foxes) would be temporarily displaced to other habitats by mining, potentially resulting in increased competition and mortality. However, these animals would rebound on reclaimed areas, as forage is developed and small mammal prey species are recolonized. Direct losses of small mammals would be higher than for other wildlife, since the mobility of small mammals is limited and many retreat into burrows when disturbed. Therefore, populations of such prey animals as voles, mice, and prairie dogs would decline during mining. However, these animals have a high reproductive potential and tend to reinvade and adapt to reclaimed areas quickly. A research project on habitat reclamation on mined lands within the PRB for small mammals and birds concluded that reclamation objectives to encourage the recolonization of small mammal communities are being achieved (Shelley 1992).

Upland game birds known to occur within the General Analysis Area include mourning doves, wild turkey, gray partridge, sharp-tailed grouse, and sage grouse. Although mourning doves are common seasonal residents of the General Analysis Area, the primary upland game species within the area is the sage grouse. Sage grouse are yearlong residents and are found to regularly occur in suitable habitats in the General Analysis Area. Following is a description of sage grouse occurrences within each of the LBA tracts.

NARO North and South LBA Tracts

Sage grouse are found on lands near the NARO North and South LBA Tracts; however, no historic or active sage grouse leks were observed during the 2001 survey on or within two miles of the two LBA tracts. One active sage grouse strutting ground (Kort Lek), is located near the northwest corner of the North Antelope/Rochelle Complex's current permit area. A small portion of the two-mile radius from the lek, which identifies the area in which most hens will nest, would extend onto the North Antelope/Rochelle Complex's anticipated permit amendment area. Sage grouse were not observed using the LBA tracts during the field survey; however, sage grouse, fresh tracks, and droppings have been observed on adjacent lands.

Little Thunder LBA Tract

Sage grouse currently do not appear to frequent the Little Thunder LBA Tract. No active sage grouse leks were observed during the 2001 survey on or within two miles of the LBA tract. One inactive sage grouse lek (Black Thunder Lek) was discovered within the Black Thunder Mine permit area in 1984 near the southeast corner of the Little Thunder LBA Tract. The two-mile radius around the lek extends onto the LBA tract. Annual monitoring of the Black Thunder Lek began in 1985, and no sage grouse have been observed at the lek since 1994. Sage grouse were

not observed using the LBA tract or adjacent lands during the 2001 field survey.

West Roundup LBA Tract

Sage grouse commonly occur in the vicinity of the West Roundup LBA Tract. One inactive lek (Black Thunder Lek) is located approximately 0.5 mile north of the proposed lease area, and the two-mile radius around the lek extends onto the LBA tract. Grouse have not been observed using this lek since 1994. No new leks were found and no sage grouse were observed to be within or adjacent to the LBA tract during the 2001 field survey.

West Antelope LBA Tract

Sage grouse do not appear to frequent the West Antelope LBA Tract. No sage grouse leks have been observed on or near the Antelope Mine during baseline studies (1978-1979) or during annual wildlife monitoring surveys (1982-2000), which have included most of the LBA tract under the Proposed Action and Alternative 3 and the entire area added in Alternative 2. No sage grouse have been observed within the vicinity of the Antelope Mine or West Antelope LBA wildlife study area since 1986.

Mining results in the temporary loss of nesting habitat and some disturbance to breeding activities when mining operations are within close proximity to sage grouse strutting grounds. Monitoring of sage grouse activities has indicated that the birds frequently change lek sites. It is likely that if mining activities disturb a lek, sage grouse will use an alternate lek site for breeding activities. Currently, none of the LBA tracts include any active sage grouse leks. Should sage grouse establish a lek on any of the proposed lease areas prior to mining, the lessee would be required to take appropriate mitigation steps prior to mining. Effort would also be made to reestablish shrubs on reclaimed lands, grade reclaimed lands to create swales and depressions, and continue monitoring sage grouse activity in the area before, during, and after mining. These and other measures would be further developed within the WDEQ/LQD permit approval process, if the tracts are leased.

Mining the LBA tracts would not impact regional raptor populations; however individual birds or pairs may be impacted. Raptor species that commonly nest in the General Analysis Area are the golden eagle, ferruginous hawk, red-tailed hawk, Swainson's hawk, great horned owl, and burrowing owl. Despite the lack of suitable nesting habitat (cliffs and tall trees), numerous raptor species have been observed nesting on or near the proposed lease areas. Following is a description of raptor occurrences on each of the LBA tracts.

NARO North and South LBA Tracts

Nine active raptor nests were observed during the 2000 survey in the NARO North and South LBA Tracts. These included four ferruginous hawk nests, one red-tailed hawk nest, and four Swainson's hawk nests.

Little Thunder LBA Tract

A total of five raptor species have been identified nesting within two miles of the Little Thunder LBA Tract as proposed and the area added by Alternative 2, including the golden eagle, ferruginous hawk, red-tailed hawk, Swainson's hawk, and burrowing owl. The golden eagle, ferruginous hawk, and Swainson's hawk had intact nest sites on the LBA tract during the 2001 survey.

West Roundup LBA Tract

A total of four raptor species (golden eagle, ferruginous hawk, Swainson's hawk, and burrowing owl) have been identified nesting within the raptor survey area, which includes the West Roundup LBA Tract as proposed, areas added under Alternatives 2 and 3, and a two-mile radius. The 2001 survey recorded 28 intact nest sites within this raptor survey area, including three golden eagle nests, 17 ferruginous hawk nests, two Swainson's hawk nests, two burrowing owl nests, three Swainson's hawk/ferruginous hawk nests, and one golden eagle/ferruginous hawk nest. One intact nest (ferruginous hawk) is within the LBA tract as proposed, and one nest (ferruginous hawk) is within the area added under Alternative 3.

West Antelope LBA Tract

A total of five raptor species (golden eagle, ferruginous hawk, red-tailed hawk, great horned owl, and burrowing owl) have been identified nesting within the raptor survey area, which includes the West Antelope LBA Tract as proposed, lands added by Alternative 2, and a two-mile radius. The 2000 survey recorded nine nests within this raptor survey area: seven nests on the LBA tract as proposed and two nests on lands added under Alternative 2. Nests on the LBA tract include two red-tailed hawk nests, one great horned owl nest, two burrowing owl nests, one golden eagle/great horned owl nest, and one red-tailed hawk/golden eagle nest. Nests on the Alternative 2 area included two ferruginous hawk nests, which have been inactive since at least 1978.

Mining activity could cause raptors to abandon nests proximate to disturbance. USFWS recommends a one-mile buffer around all ferruginous hawk nests. USFWS and WDEQ/LQD approval would be required before mining would occur within buffer zones for future or adjacent active raptor nests. Each of the four applicant mines annually monitors territorial occupancy and nest productivity on and around their existing leases. Raptor nesting activity has frequently occurred in active mining and construction areas and the four applicant mines have successfully executed state-of-the-art mitigation techniques to protect nest productivity. There is an approved raptor mitigation plan for each of the existing applicant mines. These monitoring and mitigation plans, as required by the USFWS and WDEQ/LQD, would be amended to include the NARO North and South, Little Thunder, West Roundup, and West Antelope LBA Tracts if they are leased. Mining near raptor territories would minimally impact availability of raptor forage species. At each of the applicant mines, lack of nesting

habitat, not a lack of forage area, has been determined to be the most important factor limiting raptor density. During mining, nesting habitat is created by the excavation process (highwalls), as well as through enhancement efforts (nest platforms and boxes). After mining, the reclamation plan would reestablish the ground cover necessary for the return of a suitable prey base.

Displaced songbirds would have to compete for available adjacent territories and resources when their habitats are disturbed by mining operations. Where adjacent habitat is at carrying capacity, this competition would result in some mortality. Losses would also occur when habitat disturbance coincides with egg incubation and rearing of young. Impacts of habitat loss would be short-term for grassland species, but would last longer for tree- and shrub-dependent species. Concurrent reclamation would minimize these impacts. A diverse seed mixture planted in a mosaic with a shrubland phase would provide food, cover, and edge effect. Other habitat enhancement practices include the restoration of diverse landforms, direct topsoil replacement, and the construction of brush piles, snags and rock piles. A research project on habitat reclamation on mined lands within the PRB for small mammals and birds concluded that the diversity of song birds on reclaimed areas was less than on adjacent undisturbed areas, although their overall numbers were greater (Shelley 1992).

Under current natural conditions, waterfowl and shorebird habitat on the LBA tracts is minimal, and production of these species is very limited. Mining the LBA tracts would thus have a negligible effect on migrating and breeding waterfowl. Sedimentation ponds created during mining would provide interim habitat for these fauna. WDEQ and COE would also require mitigation of any disturbed wetlands during reclamation, which would minimize impacts. If the replaced wetlands on the LBA tracts do not duplicate the exact function and/or landscape features of the premine wetlands, waterfowl and shorebirds could be beneficially or adversely affected as a result.

No fish habitat would be impacted if the NARO North and South, Little Thunder, or West Roundup LBA Tracts are leased and mined. Fish habitat occurs on the West Antelope LBA Tract, but is limited by the intermittent nature of Antelope Creek in this area. Three fish species tolerant of intermittent stream flows were found during a 1980 survey: sand shiner, flathead minnow, and plains killifish. ACC's approved mining plan avoids disturbing Antelope Creek and an adjacent designated buffer zone. Since ACC does not plan to disturb Antelope Creek during mining, fish habitat would not be affected if the West Antelope LBA Tract is leased by the applicant mine.

The impacts discussed above would apply to each action alternative for each applicant mine. The assessment of impacts to wildlife by mining the LBA tracts would be addressed during the WGFD and WDEQ/LQD review of each mine's permit

application, and within the WDEQ/LQD permit approval process.

4.1.11 Threatened, Endangered, Proposed, and Candidate Wildlife Species and USFS Region 2 Sensitive Species

Refer to Appendix G.

4.1.12 Land Use and Recreation

The major adverse environmental consequences of the Proposed Actions and action alternatives on land use would be the reduction of livestock grazing (cattle and sheep), loss of wildlife habitat (particularly big game), and curtailment of oil and gas development during mining of the coal and reclamation. Wildlife and livestock use would be displaced while the tracts are being mined and reclaimed. Estimated disturbance areas for each LBA tract and for each alternative configuration are presented in Tables 2-1 through 2-4.

Sections 3.11 and 4.1.2 and Appendix G of this document address the total number of producing, abandoned, or shut in oil and gas (conventional and CBM) wells that presently exist on the LBA tracts under the Proposed Actions and Alternatives 2 and 3. Well location information, federal oil and gas ownership, and federal oil and gas lessee information are presented in Figures 3-10 through 3-13 and Tables 3-8 through 3-11. BLM manages federal lands on a multiple use basis, in accordance with the regulations. In response to conflicts between oil and gas and coal lease holders, BLM has issued a policy statement on conflicts between CBM and coal development (BLM Instruction Memorandum No. 2000-081). That policy advocates optimizing the recovery of both coal and CBM resources to ensure that the public receives a reasonable return for these publicly owned resources. Optimal recovery of both coal and oil and gas resources requires negotiation and cooperation between the oil and gas lessees and the coal lessees. Currently, the Little Thunder LBA tract is the only tract within the General Analysis Area with producing CBM wells, although the other LBA tracts contain CBM wells in various stages of development (e.g., permitting, drilling, etc.). Negotiations are ongoing between the applicant mines and the existing oil and gas lessees on how to proceed with both operations if the coal tracts are leased. Royalties have been and would be lost to both the state and federal governments if conventional oil and gas wells are abandoned prematurely, if the federal CBM is not recovered prior to mining, or if federal coal is not recovered due to conflicts. State and federal governments can also lose bonus money when the costs of the agreements between the lessees are factored into the fair market value determinations.

As discussed in Section 3.11 of this document, the NARO North, Little Thunder, and West Roundup LBA Tracts include federal lands, which are administered by the USFS. As many as 4,076.4 acres of federal lands would be removed from public access if these LBA tracts were leased under the maximum tract area configurations. The loss of accessibility to federal lands is long term (during mining and reclamation), but is not permanent.

Public access to federal lands would be restored after mining and reclamation are complete.

A number of federal/non-federal lands exchanges between the USFS and private interests have been completed on the TBNG. These exchanges have helped to eliminate isolated parcels of federal lands and consolidate federal land ownership and to improve public access to federal lands in the TBNG. Some of the PRB coal mines have participated in partnerships with USFS in facilitating some of these exchanges.

Hunting on the LBA tracts would be eliminated during mining and reclamation. Pronghorn, mule deer, and elk occur on and adjacent to the LBA tracts. Sage grouse, mourning dove, waterfowl, rabbit, and coyote also inhabit these tracts. Mining the NARO North, Little Thunder, and West Roundup LBA Tracts would remove public access to federal land in pronghorn Hunt Area 27, mule deer Hunt Area 10, and elk Hunt Area 113. None of the lands included in NARO South or West Antelope LBA Tracts are managed by the USFS; thus, no federal lands would be removed from public access if either of these LBA tracts were leased.

Following reclamation, the land would be suitable for grazing and wildlife uses, which are the historic land uses. The reclamation standards required by SMCRA and Wyoming State Law meet the standards and guidelines for healthy rangelands for public lands administered by the BLM in the State of Wyoming. Following reclamation bond release, management of the privately owned surface would revert to the private surface owner and management of the federally owned surface would revert to the federal surface managing agency (USFS).

4.1.13 Cultural Resources

All portions of the LBA tracts as applied for, lands added under BLM alternatives, and the applicant mines' anticipated permit amendment study areas were subjected to Class I and Class III cultural resource inventories in 1999 and 2001. The results of these inventories are summarized in Section 3.12.

Data recovery plans are required for all sites recommended eligible to the National Register following testing and consultation with the SHPO. Until consultation with SHPO has occurred and agreement regarding NRHP eligibility has been reached, all sites would be protected from disturbance.

Full consultation with SHPO must be completed prior to approval of the MLA mining plan. At that time, those sites determined to be unevaluated or eligible for the NRHP through consultation would receive further protection or treatment. Impacts to eligible or unevaluated cultural resources cannot be permitted. If unevaluated sites cannot be avoided, they must be evaluated prior to disturbance. If eligible sites cannot be avoided, a data recovery plan must be implemented prior to disturbance. Ineligible properties may be destroyed without further work.

The eligible sites on each LBA tract that cannot be avoided or that have

not already been subjected to data recovery action would be carried forward in the mining and reclamation plan as requiring protective stipulations until a testing, mitigation, or data recovery plan is developed to address the impacts to the sites. The lead federal and state agencies would consult with Wyoming SHPO on the development of such plans and the manner in which they are carried out.

Cultural resources adjacent to the mine areas may be impacted as a result of increased access to the areas. There may be increased vandalism and unauthorized collecting associated with recreational activity and other pursuits outside of but adjacent to mine permit areas.

4.1.14 Native American Concerns

No sites of Native American religious or cultural importance have been identified within the General Analysis Area. If such sites or localities are identified at a later date, appropriate action must be taken to address concerns related to those sites.

4.1.15 Paleontological Resources

No unique or significant paleontological resources have been identified within the NARO North and South, Little Thunder, or West Antelope LBA Tract. One fossilized bone fragment was found within the West Roundup LBA Tract study area; however, the likelihood of encountering any further significant paleontological resources during mining activities is small. Lease and permit conditions require that should previously unknown, potentially significant paleontological sites be discovered, work in that area shall stop and measures be taken to assess and protect the site (see Appendix D).

4.1.16 Visual Resources

Most mining activities on the LBA tracts would not be visible from any major travel routes because the tracts are not close to major highways and because of the variable terrain in the General Analysis Area. However, much of the Little Thunder LBA Tract would be visible from State Highway 450, which bisects the tract. Existing mining operations at the Black Thunder and Jacobs Ranch Mines are currently visible from this highway. Portions of each LBA tract would also be visible from State Highway 59, Hilight Road, Edwards Road, Reno Road, Antelope Road, and/or Converse County Road 37. Due to existing mining activities in the five southern mines, the predominant BLM ARM class in the General Analysis Area is IV. This classification would not be altered by the leasing and subsequent mining of the five LBA tracts under any of the action alternatives. After reclamation of the LBA tracts and adjoining mines, the VRM classification would improve. No unique visual resources have been identified on or near the LBA tracts.

Reclaimed terrain would be almost indistinguishable from the surrounding undisturbed terrain. Slopes might appear smoother (less intricately dissected) than undisturbed terrain, and sagebrush would not be as abundant for several years; however, within a few years after reclamation, the mined land

would not be distinguishable from the surrounding undisturbed terrain except by someone very familiar with landforms and vegetation.

4.1.17 Noise

Noise levels on the LBA tracts would be increased considerably by mining activities such as blasting, loading, hauling, and possibly in-pit crushing. Since the LBA tracts would be mined as extensions of existing operations under the Proposed Actions or action alternatives, no rail car loading would take place on the LBA tracts. The Noise Control Act of 1972 indicates that a 24-hour equivalent level of less than 70 dBA prevents hearing loss and that a level below 55 dBA, in general, does not constitute an adverse impact. OSM prepared a noise impact report for the Caballo Rojo Mine (OSM 1980) that determined that the noise level from crushers and a conveyor would not exceed 45 dBA at a distance of 1,500 ft. Explosives would be used during mining to fragment the overburden and coal and facilitate their excavation. The air overpressure created by such blasting is estimated to be 123 dBA at the location of the blast. At a distance of approximately 1,230 ft, the intensity of this blast would be reduced to 40 dBA. Following is a description of the dwellings located near each LBA tract.

NARO North and South LBA Tracts

The nearest occupied dwelling to the NARO North and South LBA Tracts is located adjacent to the southern edge of the NARO North LBA Tract. Since this occupied dwelling is separated from the LBA tract by a distance of less than 200 yards, significant noise impacts are expected.

Little Thunder LBA Tract

The nearest occupied dwelling to the Little Thunder LBA Tract is located approximately one mile from the western edge of the tract as proposed and 0.5 mile from the area added under Alternatives 2 and 3 (South tract). Since this occupied dwelling is at least 0.5 mile (approximately 2,640 ft) from the LBA tract under any configuration, there should be no major noise impacts.

West Roundup LBA Tract

The nearest occupied dwelling to the West Roundup LBA Tract is located just over three miles from the southern edge of the tract. No major noise impacts are expected for this dwelling.

West Antelope LBA Tract

The nearest occupied dwelling to the West Antelope LBA Tract is located approximately one mile from the western edge of the tract. No major noise impacts are expected for this dwelling.

Because of the remoteness of the LBA tracts and because mining is already ongoing in the area, noise would have few off-site impacts. Wildlife in the immediate vicinity of mining may be adversely affected; however, observations at surface coal mines in the area indicate that wildlife have generally adapted to increased noise associated with coal mining activity. After mining and reclamation are

completed, noise would return to premining levels.

4.1.18 Transportation Facilities

No new or reconstructed transportation facilities would be required under the Proposed Action or action alternatives. Essentially all of the coal mined on the LBA tracts would be transported by the existing rail system. Vehicular traffic to and from the mines would continue at existing or slightly higher levels for an extended period of time, depending on which LBA tracts are leased and which alternatives are selected.

Active pipelines and power transmission lines currently cross the LBA tracts. Any relocation of these pipelines and utility lines would be handled according to specific agreements between the coal lessee and the pipeline and utility owners if the need arises. The Wyoming Department of Transportation routinely monitors traffic volumes on area highways, and if traffic exceeds design standards improvements are made. BNSF & UP have upgraded and will continue to upgrade their rail capacities to handle the increasing coal volume projected from the PRB, with or without the leasing of the proposed SPRB LBA Tracts. Likewise, the DM&E Railroad is proposing an expansion into the SPRB area which is not dependent on leasing the tracts evaluated in this EIS.

4.1.19 Socioeconomics

Socioeconomic impacts resulting from the leasing and subsequent mining of the LBA tracts would include increasing federal, state, and local revenues, extending the lives of the affected mines, and increasing employment.

Increases in federal and state revenues generated by the leasing and mining of the LBA tracts would depend on which alternatives are selected and the sale price of the coal. Although spot prices in 2001 were often higher than recent previous years, spot prices in 2002 have returned to previous levels and WSGS is predicting that coal prices will remain relatively constant over the next five years (WSGS 2001). A conservatively low estimate for coal prices over the lives of the leases is $5.00 per ton.

The federal government would collect a royalty at the time the coal is sold in the amount of 12.5 percent of the sale price. In addition, the federal government receives a bonus payment at the time the federal coal is leased. Bonus payments on the federal coal leases issued in the PRB since 1990 have ranged from 11.1 cents per ton to 70.6 cents per ton and have averaged 26 cents per ton. Additional federal fees include the AML reclamation fee (35 cents per ton sold), and the Black Lung Disability Trust Fund fee (four percent of the sales price). Royalty and bonus bid payments are divided equally with the State of Wyoming, while half of Wyoming's AML contributions are earmarked for later use in the state. Projected federal revenues for each LBA tract are presented in Tables 4-12 through 4-15 and Figure 4-13, assuming an average coal price of $5.00 per ton recovered and a bonus payment on the leased (in-place) coal of 26 cents per ton. If the five LBA

tracts were leased and mined under the Proposed Actions, cumulative federal revenues would be about $1.1 billion.

According to a study done by the University of Wyoming (UW 1994), the State of Wyoming received about $1.10 per ton from the sale of PRB coal produced in 1991. The taxes and royalties included in this calculation were severance taxes, ad valorem taxes, sales and use taxes, and the state's share of federal royalty payments on production. Although severance tax rates have been reduced from 10.5 percent to seven percent since 1991, Section 3.18 demonstrates that Wyoming revenues remain at approximately $1.10 per ton due to increased bonus bid revenues. Projected state revenues for each LBA tract are presented in Tables 4-12 through 4-15 and Figure 4-13. If the five LBA tracts were leased and mined under the Proposed Actions, cumulative state revenues would be about $1.5 billion.

As indicated by Tables 4-12 through 4-15, leasing and subsequently mining the LBA tracts would extend the life of each mine by 0 to 11 years, depending on which alternatives are selected. In addition, the leases would result in the need for 0 to 176 additional employees at each mine, with a cumulative increase of up to 186 employees. The February 2002 unemployment in Campbell and Converse Counties totaled 1,075 (Wyoming Department of Employment 2002a). It is likely that the additional employees would be available from the existing workforce in Campbell and Converse Counties. No additional demands on the existing infrastructure or services in these communities would be expected because no influx of new residents would be needed to fill new jobs. The economic stability of the communities of Douglas, Wright, and Gillette would benefit by having the current North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mine employees living in their communities employed for up to 11 additional years.

Issues relating to the social, cultural, and economic wellbeing and health of minorities and low-income groups are termed Environmental Justice issues. In reviewing the impacts of the Proposed Actions and Alternatives 2 and 3 for each LBA tract on socioeconomic resources, surface water and groundwater quality, air quality, hazardous materials, or other

Table 4-12. Projected Socioeconomic Impacts from Leasing the NARO North and South LBA Tracts under the Proposed Action or Action Alternatives.

Item	Proposed Action	Alternative 2	Alternative 3
State Revenues	$ 557.6 mm	$ 675.3 mm	$ 478.4 mm
Federal Revenues	$ 421.8 mm	$ 514.4 mm	$ 359.4 mm
Increased Mine Life	4 yrs	5.5 yrs	3 yrs
Additional Employees	10	10	10

Table 4-13. Projected Socioeconomic Impacts from Leasing the Little Thunder LBA Tract under the Proposed Action or Action Alternatives.

Item	Proposed Action	Alternative 2	Alternative 3 (North Tract)	Alternative 3 (South Tract)
State Revenues	$ 484.0 mm	$ 608.3 mm	$ 123.1 mm	$ 485.2 mm
Federal Revenues	$ 364.8 mm	$ 470.6 mm	$ 97.2 mm	$ 373.6 mm
Increased Mine Life	8 yrs	10.7 yrs	0.3 yrs	8 yrs
Additional Employees	0	0	0	0

Table 4-14. Projected Socioeconomic Impacts from Leasing the West Roundup LBA Tract under the Proposed Action or Action Alternatives.

Item	Proposed Action	Alternative 2	Alternative 2 Plus Lease WYW-127221 Modification	Alternative 3	Alternative 3 Plus Lease WYW-127221 Modification
State Revenues	$ 171.5 mm	$ 222.3 mm	$ 235.2 mm	$ 271.5 mm	$ 284.4 mm
Federal Revenues	$ 129.7 mm	$ 168.1 mm	$ 177.9 mm	$ 205.3 mm	$ 215.1 mm
Increased Mine Life	4.5 yrs	5.8 yrs	6.1 yrs	6.7 yrs	7.1 yrs
Additional Employees	176	176	176	176	176

Table 4-15. Projected Socioeconomic Impacts from Leasing the West Antelope LBA Tract under the Proposed Action or Action Alternatives.

Item	Proposed Action	Alternative 2	Alternative 3
State Revenues	$ 251.2 mm	$ 279.7 mm	$ 187.4 mm
Federal Revenues	$ 195.2 mm	$ 216.7 mm	$ 143.4 mm
Increased Mine Life	0 yrs	0 yrs	0 yrs
Additional Employees	0	0	0

Figure 4-13

elements of the human environment in this chapter, it was determined that potentially adverse impacts do not disproportionately affect Native American tribes, minority groups, or low-income groups.

With regard to Environmental Justice issues affecting Native American tribes or groups, the General Analysis Area contains no tribal lands or Native American communities, and no treaty rights or Native American trust resources are known to exist for this area.

Implementing any of the alternatives would have no effects on Environmental Justice issues, including the social, cultural, and economic wellbeing and health of minorities and low-income groups within the General Analysis Area.

4.1.20 Hazardous and Solid Waste

If the applicant mines acquire the five LBA tracts, the wastes that would be generated in the course of mining the tracts would be similar to those currently being generated by the existing mining operations. The procedures that are used for handling hazardous and solid waste at the existing mines are described in Chapter 2. Wastes generated by mining the LBA tracts would be handled in accordance with the existing regulations using the procedures currently in use at the North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mines, as described in Chapter 2.

4.2 No Action Alternative

There are five No Action Alternatives, one for each LBA tract. Under the No Action Alternative for each LBA tract, the coal lease application for that tract would be rejected and the area included in that tract would not be offered for lease at this time. If a decision is made to reject an application for an LBA tract included in this analysis, the tract could be nominated for lease again in the future but, for the purposes of this analysis, the No Action Alternative assumes that a tract would never be mined if the decision is to reject the application at this time. If an application is rejected for a tract, the approved mining operations for the existing applicant mine would not be changed.

If the No Action alternative is selected for any of the tracts included in this analysis, the impacts described on the preceding pages and in Table 2-5 to topography and physiography, geology and minerals, soils, air quality, water resources, alluvial valley floors, wetlands, vegetation, wildlife, threatened, endangered and candidate species, land use and recreation, cultural resources, Native American concerns, paleontological resources, visual resources, noise, transportation, and socioeconomics would occur on the existing adjacent coal leases under the No Action Alternative, but coal removal would not occur on the rejected LBA tract.

The general nature and magnitude of cumulative impacts as summarized in Table 2-5, which would occur from implementation of all five of the Proposed Actions or respective

Alternatives 2 or 3, would not be substantially different under one or more of the No Action Alternatives.

Under the No Action Alternatives for the NARO North and NARO South LBA Tracts, coal removal and associated disturbance and impact would not occur on 5,590, 6,275, or 4,863 acres adjacent to the existing North Antelope/Rochelle Complex under the Proposed Action, Alternative 2, or Alternative 3, respectively. Portions of the NARO North and South LBA Tracts adjacent to the existing North Antelope/Rochelle Complex would be disturbed to recover the coal in the existing leases. The economic benefits that would be derived from mining the NARO North and South LBA Tracts during an additional 5.5 years of mining would be lost.

Under the No Action Alternative for the Little Thunder LBA Tract, coal removal and associated disturbance and impact would not occur on 5,424 or 6,577 acres adjacent to the existing Black Thunder Mine under the Proposed Action or Alternative 2 and Alternative 3 (North and South tracts), respectively. Portions of the Little Thunder LBA Tract adjacent to the existing Black Thunder Mine would be disturbed to recover the coal in the existing leases. The economic benefits that would be derived from mining the Little Thunder LBA Tract during an additional 10.7 years of mining would be lost.

Under the No Action Alternative for the West Roundup LBA Tract, coal removal and associated disturbance and impact would not occur on 3,161, 3,161, or 3,591 acres adjacent to the North Rochelle Mine under the Proposed Action, Alternative 2 (with or without Lease WYW-127221 modification), or Alternative 3 (with or without Lease WYW-127221 modification), respectively. Portions of the West Roundup LBA Tract adjacent to the existing North Rochelle Mine would be disturbed to recover the coal in the existing leases. The economic benefits that would be derived from mining the West Roundup LBA Tract during an additional 7.1 years of mining would be lost.

Under the No Action Alternative for the West Antelope LBA Tract, coal removal and associated disturbance and impact would not occur on 3,200, 3,500, or 2,467 acres in adjacent to the existing Antelope Mine under the Proposed Action, Alternative 2, or Alternative 3, respectively. Portions of the West Antelope LBA Tract adjacent to the existing Antelope Mine would be disturbed to recover the coal in the existing leases. The economic benefits that would be derived from mining the West Antelope LBA Tract would be lost.

If a decision is made not to lease one or more of the five LBA tracts at this time, they could be leased and mined as maintenance leases in the future, while the existing adjacent mines are in operation. If they are not leased while the existing adjacent mines are in operation, they may or may not be leased in the future.

4.3 Regulatory Compliance, Mitigation, and Monitoring

In the case of surface coal mining, SMCRA and state law require mitigation and monitoring designed to ensure that reclamation standards are met following mining. Measures that are required by regulation are considered to be part of the Proposed Actions and the alternatives considered in this EIS for the NARO North, NARO South, Little Thunder, West Roundup, and West Antelope LBA Tracts. These requirements, mitigation plans, and monitoring plans are in place for the No Action Alternative, as part of the current approved mining and reclamation plans for the existing North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mines. These requirements, mitigation plans, and monitoring plans would be included in the mining and reclamation plan revision that would be required for each respective LBA tract that is leased. This mining and reclamation plan revision would have to be approved before mining could occur on each tract that is leased, regardless of who acquires the tract. The major mitigation measures and monitoring measures that are required by state or federal regulation are summarized in Table 4-16. More specific information about some of these mitigation and monitoring measures and their results at the North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mines are described in the following sections of this document:

- Section 3.5.5, control measures for particulate emissions;
- Section 3.5.6, control measures for blasting emissions;
- Section 4.1.2, handling of unsuitable overburden material and backfill monitoring plans;
- 4.1.3, structures to control soil erosion;
- Section 4.1.4, air quality monitoring and modeling practices and results and application of BACT for mitigation of air quality impacts;
- Section 4.1.5, surface water hydrologic control measures;
- Section 4.1.5, groundwater quantity and quality monitoring measures and results;
- groundwater drawdown modeling requirements;
- Section 4.1.5, mitigation for interruption, discontinuation, or diminishment of existing water well rights by mining operations;
- Section 4.1.6, restoration of AVFs impacted by mining;
- Section 4.1.7, identification and replacements of wetlands impacted by mining;
- mandated reclamation seed mixtures;
- Section 4.1.8, plans for control of invasive, nonnative plant species;
- Section 4.1.10, fencing designed to permit pronghorn passage;
- Section 4.1.10, big game monitoring results and requirements;
- Section 4.1.10, notification and mitigation measures to protect active raptor nests and nest productivity;

Table 4-16. Regulatory Compliance, Mitigation and Monitoring Measures required under each Proposed Action, Alternative 1 (No Action), Alternative 2, or Alternative 3.

Resource	Regulatory Compliance or Mitigation Required by Stipulations or Required by State or Federal Law[1]	Monitoring[1]
Topography & Physiography	Restoring to approximate original contour or other approved topographic configuration	LQD checks as-built vs. approved topography with each annual report
Geology & Minerals	Identifying & selectively placing or mixing chemically or physically unsuitable overburden materials to minimize adverse effects to vegetation or groundwater	LQD requires monitoring in advance of mining to detect unsuitable overburden
Soil	Salvaging soil suitable to support plant growth for use in reclamation; Protecting soil stockpiles from disturbance and erosional influences; Selectively placing at least 4 ft of suitable overburden on the graded spoil surface below replaced topsoil to meet guidelines for vegetation root zones	Monitoring vegetation growth on reclaimed areas to determine need for soil amendments; Sampling regraded overburden for compliance with root zone criteria
Air Quality	Dispersion modeling of mining plans for annual average particulate pollution impacts on ambient air; Using particulate pollution control technologies; Using work practices designed to minimize fugitive particulate emissions; Using EPA- or state-mandated BACT, including: Fabric filtration or wet scrubbing of coal storage silo and conveyor vents, Watering or using chemical dust suppression on haul roads and exposed soils, Containment of truck dumps and primary crushers, Covering of conveyors, Prompt revegetation of exposed soils	On-site air quality monitoring for PM_{10}; Off-site ambient monitoring for PM_{10}; On-site compliance inspections
Surface Water	Building and maintaining sediment control ponds or other devices during mining; Restoring approximate original drainage patterns during reclamation; Restoring stock ponds and playas during reclamation	Monitoring storage capacity in sediment ponds; Monitoring quality of discharges; Monitoring streamflows and water quality
Groundwater Quantity	Evaluating cumulative impacts to water quantity associated with proposed mining; Replacing existing water rights that are interrupted, discontinued, or diminished by mining with water of equivalent quantity	Monitoring wells track water levels in overburden, coal, interburden, underburden, & backfill

[1] These requirements, mitigation plans, and monitoring plans are in place for the existing North Antelope/Rochelle Complex, Black Thunder, North Rochelle and Antelope Mines in their current approved mining and reclamation plans (the No Action Alternatives). If the NARO North, NARO South, Little Thunder, West Roundup or West Antelope LBA Tracts are leased, these requirements, mitigation plans, and monitoring plans would be part of a mining plan revision covering the NARO North, NARO South, Little Thunder, West Roundup or West Antelope LBA Tracts that must be approved before mining can occur on the tract under the Proposed Action, Alternative 2 or 3.

Table 4-16. Regulatory Compliance, Mitigation and Monitoring Measures required under each Proposed Action, Alternative 1 (No Action), Alternative 2, or Alternative 3. (Continued)

Resource	Regulatory Compliance or Mitigation Required by Stipulations or Required by State or Federal Law[1]	Monitoring[1]
Groundwater Quality	Evaluating cumulative impacts to water quality associated with proposed mining; Replacing existing water rights that are interrupted, discontinued, or diminished by mining with water of equivalent quality	Monitoring wells track water quality in overburden, coal, interburden, underburden, & backfill
Alluvial Valley Floors	Identifying all AVFs that would be affected by mining; Determining significance to agriculture of all identified AVFs affected by mining (WDEQ); Protecting downstream AVFs during mining; Restoring essential hydrologic function of all AVFs affected by mining	Monitoring to determine restoration of essential hydrologic functions of any declared AVF
Wetlands	Identifying all wetlands that would be affected by mining; Identifying jurisdictional wetlands (COE); Replacing all jurisdictional wetlands that would be disturbed by mining; Replacing functional wetlands as required by surface managing agency or surface land owner	Monitoring of reclaimed wetlands using same procedures used to identify premining jurisdictional wetlands
Vegetation	Permanently revegetating reclaimed areas according to a comprehensive revegetation plan using approved permanent reclamation seed mixtures consisting predominantly of species native to the area; Reclaiming 20 percent of reclaimed area with native shrubs at a density of one per square meter; Controlling erosion on reclaimed lands prior to seeding with final seed mixture using mulching, cover crops, or other approved measures; Chemically and mechanically controlling weed infestation; Direct hauling of topsoil; Selectively planting shrubs in riparian areas; Planting sagebrush; Creating depressions and rock piles; Using special planting procedures around rock piles; Posting reclamation bond covering the cost of reclamation	Monitoring of revegetation growth & diversity until release of final reclamation bond (minimum 10 years); Monitoring of erosion to determine need for corrective action during establishment of vegetation; Use of controlled grazing during revegetation evaluation to determine suitability for postmining land uses

[1] These requirements, mitigation plans, and monitoring plans are in place for the existing North Antelope/Rochelle Complex, Black Thunder, North Rochelle and Antelope Mines in their current approved mining and reclamation plans (the No Action Alternatives). If the NARO North, NARO South, Little Thunder, West Roundup or West Antelope LBA Tracts are leased, these requirements, mitigation plans, and monitoring plans would be part of a mining plan revision covering the NARO North, NARO South, Little Thunder, West Roundup or West Antelope LBA Tracts that must be approved before mining can occur on the tract under the Proposed Action, Alternative 2 or 3.

Table 4-16. Regulatory Compliance, Mitigation and Monitoring Measures required under each Proposed Action, Alternative 1 (No Action), Alternative 2, or Alternative 3. (Continued)

Resource	Regulatory Compliance or Mitigation Required by Stipulations or Required by State or Federal Law[1]	Monitoring[1]
Wildlife	Restoring premining topography to the maximum extent possible; Planting a diverse mixture of grasses, forbs and shrubs in configurations beneficial to wildlife; Designing fences to permit wildlife passage; Raptor-proofing power transmission poles; Creating artificial raptor nest sites; Increasing habitat diversity by creating rock clusters and shallow depressions on reclaimed land; Cottonwood plantings along reclaimed drainages; Replacing drainages, wetlands and AVFs disturbed by mining; Reducing vehicle speed limits to minimize mortality; Instructing employees not to harass or disturb wildlife; Preparing raptor mitigation plans	Baseline & annual wildlife monitoring surveys; Monitoring for Migratory Birds of Management Concern
Threatened, Endangered, Proposed, & Candidate Species	Avoiding bald eagle disturbance; Restoring bald eagle foraging areas disturbed by mining; Restoring mountain plover habitat disturbed by mining; Using raptor safe power lines; Surveying for Ute ladies' tresses; Surveying for mountain plover; Searching for black-footed ferrets if prairie dogs move onto tract	Baseline and annual wildlife monitoring surveys
Land Use	Suitably restoring reclaimed area for historic uses (grazing and wildlife)	Monitoring of controlled grazing prior to bond release evaluation
Cultural Resources	Conducting Class I & III surveys to identify cultural properties on all state and federal lands and on private lands affected by federal undertakings; Consulting with SHPO to evaluate eligibility of cultural properties for the NRHP; Avoiding or recovering data from significant cultural properties identified by surveys, according to an approved plan; Notifying appropriate federal personnel if historic or prehistoric materials are uncovered during mining operations; Instructing employees of the importance of and regulatory obligations to protect cultural resources	Monitoring of mining activities during topsoil stripping; Cessation of activities and notification of authorities if unidentified sites are encountered during topsoil removal

[1] These requirements, mitigation plans, and monitoring plans are in place for the existing North Antelope/Rochelle Complex, Black Thunder, North Rochelle and Antelope Mines in their current approved mining and reclamation plans (the No Action Alternatives). If the NARO North, NARO South, Little Thunder, West Roundup or West Antelope LBA Tracts are leased, these requirements, mitigation plans, and monitoring plans would be part of a mining plan revision covering the NARO North, NARO South, Little Thunder, West Roundup or West Antelope LBA Tracts that must be approved before mining can occur on the tract under the Proposed Action, Alternative 2 or 3.

Table 4-16. Regulatory Compliance, Mitigation and Monitoring Measures required under each Proposed Action, Alternative 1 (No Action), Alternative 2, or Alternative 3. (Continued)

Resource	Regulatory Compliance or Mitigation Required by Stipulations or Required by State or Federal Law[1]	Monitoring[1]
Native American Concerns	Notifying Native American tribes with known interest in this area of leasing action and request for help in identifying potentially significant religious or cultural sites	No specific monitoring program
Paleontological Resources	Notifying appropriate federal personnel if potentially significant paleontological sites are discovered during mining	No specific monitoring program
Visual Resources	Restoring landscape character during reclamation through return to approximate original contour and revegetation with native species	No specific monitoring program
Noise	Protecting employees from hearing loss	MSHA inspections
Transportation Facilities	Relocating existing pipelines, if necessary, in accordance with specific agreement between pipeline owner and coal lessee	No specific monitoring program
Socioeconomics	Paying royalty and taxes as required by federal, state, and local regulations	Surveying and reporting to document volume of coal removed
Hazardous & Solid Waste	Disposing of solid waste and sewage within permit boundaries according to approved plans; Storing and recycling waste oil; Maintaining of files containing Material Safety Data Sheets for all chemicals, compounds, and/or substances used during course of mining; Ensuring that all production, use, storage, transport, and disposal of hazardous materials is in accordance with applicable existing or hereafter promulgated federal, state, and government requirements; Complying with emergency reporting requirements for releases of hazardous materials as established in CERCLA, as amended; Preparing and implementing spill prevention control and countermeasure plans, spill response plans, inventories of hazardous chemical categories pursuant to Section 312 of SARA, as amended; Preparing emergency response plans	No specific monitoring other than required by these other regulations and response plans

[1] These requirements, mitigation plans, and monitoring plans are in place for the existing North Antelope/Rochelle Complex, Black Thunder, North Rochelle and Antelope Mines in their current approved mining and reclamation plans (the No Action Alternatives). If the NARO North, NARO South, Little Thunder, West Roundup or West Antelope LBA Tracts are leased, these requirements, mitigation plans, and monitoring plans would be part of a mining plan revision covering the NARO North, NARO South, Little Thunder, West Roundup or West Antelope LBA Tracts that must be approved before mining can occur on the tract under the Proposed Action, Alternative 2 or 3.

- Section 4.1.10, mitigation measures to minimize habitat loss impacts to songbirds;
- Section 4.1.13, protection of cultural resources that are recommended eligible for or of undetermined eligibility for the NRHP; and
- Appendix G, protection of threatened, endangered, proposed, and candidate species.

If impacts are identified during the leasing process that are not mitigated by existing required mitigation measures, BLM can include additional mitigation measures, in the form of stipulations on the new lease, within the limits of its regulatory authority. In general, the levels of mitigation and monitoring required for surface coal mining by SMCRA and Wyoming state law are more extensive than those required for other surface disturbing activities; however, concerns are periodically identified that are not monitored or mitigated under existing procedures.

An example of this type of issue is the concern about the release of NO_x from blasting, and the resulting formation of low-lying orange clouds that can be carried outside the mine permit areas by wind. After this was identified as a potential health concern in the area of the Wyoming PRB surface coal mines, a monitoring program measuring NO_2 concentrations in areas accessible to the public near PRB coal mining operations was conducted in 1999 (see discussion in Section 4.1.4). In addition, WDEQ has directed some PRB mines to take steps designed to mitigate the effects of NO_2 emissions occurring from overburden blasting. The steps that may be required include: public notifications (in the form of warning signs along public roadways for example); temporary closure of public roadways near a mine during and after a blast; establishment of safe set-back distances from blasting areas; prohibiting blasting when wind direction is toward a neighbor; prohibiting blasting during temperature inversions; establishment of monitoring plans; estimation of NO_2 concentrations; and development of blasting procedures that will protect public safety and health.

After reviewing the required mitigation and monitoring in the current North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mine's Mining and Reclamation Permits and the historical monitoring results in the North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mine's annual mine reports to the WDEQ, the BLM has not identified additional special stipulations that should be added to the BLM lease or areas where additional or increased monitoring measures are recommended.

4.4 Residual Impacts

Residual impacts are unavoidable impacts that cannot be mitigated and would therefore remain following mining and reclamation.

4.4.1 Topography and Physiography

Topographic moderation is a permanent consequence of mining. The indirect impacts of topographic

moderation on wildlife habitat diversity would also be considered permanent.

4.4.2 Geology and Minerals

Geology from the base of the coal to the surface would be subject to significant, permanent change. CBM resources not recovered prior to mining would be vented to the atmosphere and permanently lost.

4.4.3 Soils

Existing soils would be mixed and redistributed, and soil-forming processes would be disturbed by mining. This would result in long-term alteration of soil characteristics.

4.4.4 Air Quality

No residual impacts to air quality would occur following mining.

4.4.5 Water Resources

The area of coal and overburden removal and replacement of overburden and associated groundwater drawdowns would be increased under the action alternatives compared with the area of coal and overburden removal and overburden replacement and associated groundwater drawdowns if one or more of the five LBA tracts is not leased and mined. The postmining backfill may take in excess of 100 years to reach equilibrium water levels and water quality. Less time would be required near the mining boundaries. Water level and water quality in the backfill would be suitable to provide water to wells for livestock use, but would be different from premining conditions.

4.4.6 Alluvial Valley Floors

No residual impacts to AVFs would occur following mining.

4.4.7 Wetlands

Replaced wetlands (jurisdictional or functional) may not duplicate the exact function and landscape features of the premining wetland, but all wetland replacement plans would be approved by COE.

4.4.8 Vegetation

Reclaimed vegetative communities may never completely match the surrounding native plant community.

4.4.9 Wildlife

Although the LBA tracts would be reclaimed to be as near original condition as possible, there would be some residual wildlife impacts. The topographic moderation would result in a permanent loss of habitat diversity and a potential decrease in slope-dependent shrub communities. This would reduce the carrying capacity of the land for shrub-dependent species.

4.4.10 Threatened, Endangered, Proposed, and Candidate Species and USFS Region 2 Sensitive Species

No residual impacts to T&E, proposed, or candidate species are expected. No residual impacts to USFS Region 2 Sensitive Species are expected.

4.4.11 Land Use and Recreation

No residual impacts to land use and recreation are expected.

4.4.12 Cultural Resources

Cultural sites that are determined to be eligible for the NRHP would be avoided if possible. Eligible sites that cannot be avoided would be destroyed by surface coal mining after data from those sites is recovered. Sites that are not eligible for the NRHP would be lost.

4.4.13 Native American Concerns

No residual impacts to Native American concerns have been identified.

4.4.14 Paleontological Resources

No residual impacts to significant paleontological resources are expected.

4.4.15 Visual Resources

No residual impacts to visual resources are expected.

4.4.16 Noise

No residual impacts to noise are expected.

4.4.17 Transportation Facilities

No residual impacts to transportation facilities are expected.

4.4.18 Socioeconomics

No residual impacts to socioeconomics are expected.

4.5 Cumulative Impacts

Cumulative impacts result from the incremental impacts of an action added to other past, present, and reasonably foreseeable future actions, regardless of who is responsible for such actions. Cumulative impacts can result from individually minor, but collectively significant, actions occurring over time.

This section briefly summarizes the cumulative impacts that are occurring as a result of existing development in the area of the North Antelope/Rochelle Complex, Black Thunder Mine, North Rochelle Mine, and Antelope Mine and considers how those impacts would change if the NARO North and South, Little Thunder, West Roundup, and West Antelope LBA Tracts are leased and mined as proposed and if other proposed development in the area occurs.

Since decertification of the Powder River Federal Coal Region in 1990, the Wyoming State Office of the BLM has held 15 competitive coal lease sales and issued 11 new federal coal leases containing approximately 3.178 billion tons of coal using the LBA process (Table 1-1). In 1992 and 1993, this leasing process underwent the scrutiny of two appeals to the Interior Board of Land Appeals and one audit by the General Accounting Office.

The Wyoming BLM has pending applications for nine additional maintenance tracts for existing mines containing about 2.3 billion tons of coal (Table 1-2). All of the pending applications have been reviewed and

recommended for processing by the PRRCT.

BLM completed one exchange in the PRB in 2000, authorized by Public Law 95-554. Under this exchange, EOG resources (formerly Belco) received a federal lease for a 106-million ton portion of the Hay Creek Tract adjacent to the Buckskin Mine in exchange for the rights to a 170-million ton coal lease near Buffalo, Wyoming that is unmineable due to construction of Interstate Highway 90 (BLM 1999b). A coal exchange proposed by Pittsburg and Midway Coal Mining Company is also currently being evaluated. As proposed, federal coal in Sheridan County, Wyoming would be exchanged for privately owned lands and minerals in Lincoln, Carbon, and Sheridan Counties, Wyoming.

Four regional EISs evaluating surface coal development in the PRB in Wyoming were previously prepared. They are:

Final Environmental Impact Statement, Eastern Powder River Basin of Wyoming, BLM, October 1974;

Final Environmental Impact Statement, Proposed Development of Coal Resources in the Eastern Powder River Basin of Wyoming, BLM, March 1979;

Final Powder River Regional Coal Environmental Impact Statement, BLM, December, 1981; and

Draft Environmental Impact Statement for Round II Coal Lease Sale in the Powder River Region, BLM, January 1984.

Since 1989, coal production in the PRB has increased by an average of 6.8 percent per year. The increasing state production is primarily due to increasing sales of low-sulfur, low-cost PRB coal to electric utilities who must comply with Phase I requirements of Title III of the 1990 Clean Air Act Amendments. Electric utilities account for 97 percent of Wyoming's coal sales. In 2001, approximately 30 percent of the coal mined in the United States came from the PRB.

The currently operational mines in Campbell and northern Converse Counties are shown in Figure 1-1. Their current status and ownership are shown in Table 4-17. There have been numerous changes in mine ownership during the last decade, and this has resulted in mine consolidations and mine closings within the basin.

The mines are located just west of the outcrop of the Wyodak coal, where the coal is at the shallowest depth. The mines in Campbell and Converse Counties currently produce over 96 percent of the coal produced in Wyoming each year. Table 4-18 summarizes predicted coal mining activity (from the 1979 and 1981 regional EISs) with actual activity that has occurred since the EISs were prepared.

Campbell and Converse Counties' oil production decreased to 14.3 million barrels of oil in 2001 from 32.8 million barrels in 1992, a 56.4 percent decrease. Oil production throughout Wyoming is expected to continue to decline, since exploration and production drilling has been very

Table 4-17. Status of Wyoming PRB Coal Mines.

2002 Mine	1994 Mine Operator	Coal Production[1] 1993 Actual[2]	Coal Production[1] 1994 Permitted[4]	2001 Mine Operator	Coal Production[1] 2001 Actual[3]	Coal Production[1] 2002 Permitted[4]	Status/Comments
Buckskin	SMC (Zeigler)	11.18	24.0	Vulcan Capital Mgmt	19.18	27.5	Active
Clovis Point	Kerr-McGee	0.00	4.0	Wyodak Resources	0.00	0.0	Mine shut down/leases relinquished or sold; facilities sold; Wyodak has AQD permit; part of Wyodak Mine
Dry Fork	Phillips/WFA	3.28	15.0	WFA	4.03	15.0	Active
Eagle Butte	Cyprus-Amax	16.70	29.6	RAG American	24.83	35.0	Active
Fort Union	Fort Union Ltd	0.06	9.3	Kennecott/KFx	0.00	9.4	Inactive
Rawhide	Carter (Exxon)	9.86	24.0	Peabody	0.00	24.0	Reopening
Wyodak	Wyodak Resources	3.03	10.0	Wyodak Resources	3.52	12.0	Active
NORTHERN MINE GROUP TOTALS		**44.11**	**115.9**		**51.56**	**122.9**	
Belle Ayr	Cyprus-Amax	15.59	25.0	RAG American	11.75	45.0	Active
Caballo	Carter (Exxon)/ Western Energy	15.42	40.0	Peabody	27.12	40.0	Active/Caballo Mine + former Rocky Butte & West Rocky Butte leases
Cordero-Rojo Complex	Kennecott/ Drummond	21.01	44.0	Kennecott	43.49	65.0	Active/Cordero + Caballo Rojo Mines
Coal Creek	ARCO	0.11	18.0	Arch	0.00	18.0	Standby
CENTRAL MINE GROUP TOTALS		**52.13**	**127.0**		**82.36**	**168.0**	
Antelope	Kennecott	7.29	12.0	Kennecott	24.64	30.0	Active
Black Thunder	ARCO	34.32	36.0	Arch	67.63	100.0	Active
Jacobs Ranch	Kerr-McGee	18.39	25.0	Kennecott	29.33	50.0	Active
N. Antelope/ Rochelle Complex	Peabody	32.94	50.0	Peabody	74.78	85-105.0	Active/North Antelope Mine + Rochelle Mine
N. Rochelle	SMC (Zeigler)	0.02	8.0	Vulcan Capital Mgmt	23.87	35.0	Active/facilities constructed in 1998-99
SOUTHERN MINE GROUP TOTALS		**92.96**	**131.0**		**220.25**	**300-320.0**	
TOTALS FOR 3 MINE GROUPS		**189.2**	**373.9**		**354.17**	**590.9-610.9**	

[1] Actual production (million tons) on left, permitted production (million tons) on right.
[2] Source: Wyoming State Geological Survey *GEO-NOTES*, August 1994.
[3] Source: Wyoming State Inspector of Mines *ANNUAL REPORT* for 2001.
[4] Source: Judy Shamley, WDEQ/AQD, personal communication March 28, 2002. Figures are permitted capacity as of October 1, 2000.

Table 4-18. Coal Production and Development Levels, Campbell and Converse Counties, Wyoming.

	Coal Production (Million Tons)	Number of Active Coal Mines	Number of Existing Power Plants	Number of Active Coal Enhancement Facilities	Direct Coal Employment	Average Price-NE Wyoming
1979 Predictions for 1990	174.3	15	2	1	3,889	na
1981 Predictions for 1990	318.4	37	3	1	11,900	na
Actual 1990	162.6	18	3	1	2,862	$6.86
Actual 1995	246.5	19	4	1	3,177	$5.60
Actual 1996	261.1	18	4	2	3,274	$5.40
Actual 1997	264.1	18	4	2	3,164	$5.03
Actual 1998	297.5	16	4	2	3,348	$4.73
Actual 1999	320.3	15[1]	4	2	3,362	$4.57
Actual 2000	323.1	12	4	2	3,335	$4.93
Actual 2001	354.1	15	4	0	3,636	$5.08

Existing Power Plants: PP&L Dave Johnston, PP&L Wyodak, Black Hills Power and Light Simpson #1, Black Hills Power and Light Simpson #2, and Black Hills Power and Light's two natural gas power plants (40Mw each) at Wyodak site.

Proposed New Power Plants: Reasonably Foreseeable: NAPG Two Elk, Black Hills Corporation Wygen I, and Black Hills Corporation Wygen II.
Not Reasonably Foreseeable: NAPG Two Elk Unit Two and NAPG Middle Bear.

Existing Coal Enhancement: SGI International ENCOAL Plant - Buckskin Mine (inactive), KFx K-Fuels Coal Pellet Plant - Fort Union Mine (inactive), and Wyodak Eartheo (inactive).

[1] Includes the Dave Johnston Mine, which is not included in Table 4-17.

Sources: 1979 and 1981 BLM PRB Regional EISs, Wyoming State Geological Survey GEO-NOTES-1996-2001, and Wyoming State Inspector of Mines Annual Reports, 1990-2001.
Donald R. McKenzie, WDEQ/LQD, personal communication March 29, 2002.

weak and old oil fields with declining production produce most of Wyoming's oil (WSGS 2002a).

Natural gas production has been increasing, particularly in Campbell County, due to the development of shallow CBM resources west of the coal mines. CBM exploration and development is currently ongoing throughout the PRB in Wyoming.

Since the early 1990s, the BLM has completed numerous EAs and three EISs analyzing CBM projects. The latest of these is the *Draft Environmental Impact Statement and Draft Planning Amendment for the Powder River Basin Oil and Gas Project*, which was completed in January 2002. The project area for this EIS includes almost eight million acres of mixed federal, state, and private lands within the Wyoming portion of the PRB. This EIS analyzes the cumulative impacts of reasonably foreseeable CBM and conventional oil and gas development. It will be used to update the BLM planning documents in the area of proposed CBM development. The impacts of drilling, completing, operating, and reclaiming almost 39,400 new federal, state, and private CBM wells in addition to the roughly 12,100 federal, state, and private CBM wells already drilled or permitted for the project area. The draft EIS also analyzes the impacts of developing 3,200 new conventional oil and gas wells, as well as constructing, operating, and reclaiming various ancillary facilities needed to support the new CBM and conventional wells, including roads, pipelines for gathering gas and produced water, electrical utilities, and compressors (BLM 2002a). A final EIS is in preparation. CBM resources were not being developed when the regional coal EISs (BLM 1974, 1979, 1981, and 1984) were prepared.

CBM wells can be drilled on private and state oil and gas leases after approval by the WOGCC and the Wyoming SEO. BLM must analyze the individual and cumulative environmental impacts of all drilling (federal, state, and private), as required by NEPA, before CBM drilling on the federal oil and gas leases can be authorized. BLM does not authorize drilling on state or private leases but must consider the impacts from those wells in their NEPA analyses. In many areas of the PRB the coal estate is federally owned, but the oil and gas estate is privately owned. A June 7, 1999 Supreme Court decision (98-830) assigned the rights to develop CBM on a piece of land to the owner of the oil and gas estate.

Other mineral development levels in the Wyoming PRB are currently lower than predicted in the regional EISs. In the 1970s, significant uranium development was anticipated in southwest Campbell County and northwest Converse County. This development did not materialize because the price of uranium dropped in the early 1980s. There are currently two *in situ* uranium operations in Converse County, but no mines and no mills. There were three active *in situ* operations in the PRB in 1999, but one of them, located in southeastern Johnson County, has since ceased operations. The spot market price of uranium has increased from a low of $7.10 per

pound of yellowcake on December 13, 2000 to $9.90 per pound in late February 18, 2002 (WSGS 2002b).

Scoria is quarried for use as road surfacing material, primarily by coal mines but also by a few excavation and construction firms. Bentonite is mined in parts of the Wyoming PRB, but not in Campbell or Converse Counties.

The five LBA tracts included in this EIS are situated within a nearly continuous corridor of five coal mines in southern Campbell and northern Converse Counties, Wyoming (Figures 1-1 and 3-1). This southern mine corridor is approximately 24 miles long and eight miles wide. Production of coal in this southern mine group began in 1977 at the Black Thunder Mine. The current maximum permitted production rate for these five mines is 300 to 320 mmtpy (Table 4-17). Nine maintenance leases, including approximately 25,935 acres of federal coal, have been issued to mines in this southern group since decertification (Jacobs Ranch, West Black Thunder, North Antelope/Rochelle, Antelope, North Rochelle, Powder River, Thundercloud, Horse Creek and North Jacobs Ranch--see Table 1-1).

CBM wells have been drilled around all five mines in the southern mine corridor. CBM drilling and production is expected to continue in the areas around the coal mines, and on the LBAs. Due to the proximity of the coal mining and CBM production operations, cumulative impacts to groundwater, surface water, air quality and wildlife have occurred and are likely to continue as more CBM resources are developed adjacent to existing surface coal mines. These impacts are included in the following cumulative impact discussion for these resources.

In addition to the ongoing coal mining and leasing and the CBM development, there are other projects which are in progress or have been proposed in the Wyoming PRB. These projects include the Wygen I 90-Mw coal-fired power plant currently under construction by Black Hills Corporation near the Wyodak Mine east of Gillette; the Two Elk 300-Mw coal-fired power plant proposed for construction by NAPG east of the Black Thunder Mine; the Wygen II 500-Mw coal-fired power plant that would be built near Wyodak Mine east of Gillette by Black Hills Corporation; the proposed DM&E rail line; the Two Elk Unit Two 500-Mw coal-fired power plant, which NAPG also proposes to build east of the Black Thunder Mine; construction and operation by NAPG of another 500-Mw coal-fired power plant, the Middle Bear facility, near the Cordero-Rojo Mining Complex; and the ENCOAL coal enhancement facility, which was proposed for construction at the North Rochelle Mine but has been indefinitely delayed.

Some of these projects have advanced farther along in their respective planning and permitting processes than others and are therefore more likely to be completed in the foreseeable future. At this time, based on the status of their planning and permitting efforts, the Black Hills Corporation Wygen I and Wygen II coal-fired power plants, the NAPG

Two Elk coal-fired power plant, and the proposed DM&E rail line are considered reasonably foreseeable developments based on the status of their planning and permitting efforts. The NAPG Two Elk Unit Two coal-fired power plant and the NAPG Middle Bear coal-fired power plant are proposals which are not reasonably foreseeable at this time, and the ENCOAL coal enhancement facility is indefinitely postponed.

The two NAPG Two Elk plants and the DM&E railroad project, due to their locations, could have directly overlapping impacts with the impacts of mining the five proposed SPRB LBA Tracts.

The proposed Wygen I and II plants would be located at the Black Hills Corporation energy complex near Gillette, and the proposed NAPG Middle Bear plant would be located at the Cordero Rojo Complex. The impacts of mining the five proposed SPRB LBA Tracts would not be expected to directly overlap with the impacts of building and operating these power plants.

The planned NAPG Two Elk power plant would be a coal-fired power plant located east of Black Thunder Mine and would generate 310-Mw. The plant would burn low-Btu "waste coal" and coal fines from nearby mines as well as sub-bituminous coal in a pulverized coal boiler. The ability to burn low Btu waste coal and fines would allow the Two Elk plant to recover fuel values that might otherwise be lost and thereby generate electric power more efficiently than existing coal-fired plants. Coal and waste coal would be transported from area mines to the power plant by direct truck haul on unpaved roads, and ash would be returned to the mines by enclosed, four-wheel off-highway trucks. According to NAPG, the project has all of the permits needed except for ROW permission from the USFS to provide access for a transmission line to the power plant (Gillette News-Record 2002a). Construction has been delayed while NAPG has been attempting to secure a partner to share the cost of constructing the plant. NAPG's most recent estimates are that the project would employ a temporary construction workforce of up to 700 persons and a permanent workforce of 50. Construction could begin in 2002 (Casper Star Tribune 2002).

The Black Hills Corporation Wygen I power plant, which is now under construction, will be a 90-Mw coal-fired power plant located near Gillette, Wyoming. According to a September 27, 2000 press release, the plant would burn approximately 500,000 tons of low-sulfur coal annually. The coal could be mined at the adjacent Wyodak Mine. The plant is expected to be operational by early 2003 (Gillette News-Record 2002c). Black Hills Corporation estimates that the project will employ about 300 people during the construction period.

Black Hills Energy Capital, Inc., the independent power subsidiary of Black Hills Corporation, initiated the permitting process to build the 500-Mw Wygen II power plant in 2002. The proposed plant would adjoin its other generating plant (Wygen I) near Gillette. It would be similar in

features to the existing 360-Mw Wyodak power plant at the same location. Construction could begin on the Wygen II plant in 2003 (Gillette News-Record 2002c), and it could be operational by mid-2005 (Black Hills Corporation 2001).

The Surface Transportation Board preliminarily approved the DM&E Railroad expansion plan (to build 280 miles of new track in the PRB and to rehabilitate approximately 600 miles of track across South Dakota and Minnesota) on December 11, 1998. The approval was made pending the completion of an analysis of the environmental impacts of the project. The Surface Transportation Board released the DEIS for public comment in September 2000, and the FEIS for the DM&E PRB Expansion Project was issued November 19, 2001. On January 30, 2002 the Surface Transportation Board announced its final approval for the DM&E PRB Expansion Project, subject to a number of environmental mitigation conditions and the requirement that DM&E use an environmentally preferable route that avoids sensitive areas along the Cheyenne River. DM&E's originally proposed route in Wyoming generally followed along the Cheyenne River valley.

DM&E had originally proposed to start construction in 1999 and complete the new railroad line in 2001; however, final approval and construction could not take place until after the environmental analysis was completed. DM&E must still obtain permits or approvals from other agencies including the BLM, USFS, and COE, and several lawsuits were filed against the proposal following the Surface Transportation Board's approval of the project (WSGS 2002b).

NAPG has also announced plans to build the Two Elk Unit Two power plant, a 500-Mw facility, near the Two Elk plant adjacent to the Black Thunder Mine and the Middle Bear power plant, also a 500-Mw facility, next to the Cordero-Rojo Complex (Casper Star-Tribune 2001). The Two Elk Unit Two plant, like the Two Elk plant, would burn "waste coal" from nearby mines, while the Middle Bear plant would burn commercial-grade coal from nearby mines. If all the necessary permits and funding can be secured, NAPG originally anticipated that construction of the Two Elk Unit Two plant, which would burn about three million tons of coal per year, would occur from 2006 to 2009, and construction of the Middle Bear plant would occur from 2003 to 2006. These NAPG-proposed power plants would employ up to 1,500 temporary construction workers each (Pederson Planning Consultants 2001).

The rate of reclamation is one aspect of the surface coal mining operations where the actual levels reached in 1990 and 1995 did not meet the levels predicted for 1990 and 1995 in the regional EISs. According to the "Annual Evaluation Summary Report for the Coal Regulatory Program Administered by the Land Quality Division of the Wyoming Department of Environmental Quality for Evaluation Year 2001" (OSM 2002), in 1997, the Casper Field Office of OSM and WDEQ/LQD reviewed four mine sites in Wyoming for compliance with contemporaneous reclamation requirements and compared on-the-

ground reclamation with the approved reclamation plan in the respective permit for each of those mines. In that review, OSM and WDEQ/LQD found that the mine permits they reviewed did not set clear and concise time schedules and requirements for contemporaneous reclamation. In response to those findings, WDEQ/LQD agreed to review required reclamation schedules in all permits and revise the annual reporting format to include information about contemporaneous reclamation progress. In 2001, contemporaneous reclamation was evaluated at four randomly assigned mines. According to the OSM report cited above, the 2001 evaluation of contemporaneous reclamation "showed that reclamation was following mining disturbance at a reasonable rate. The reclamation rate at all four mines was at least 90 percent for the areas disturbed for the previous twelve months. In addition, the standards for measuring reclamation contained in the four permits were reasonably clear and concise." However, OSM's 2001 annual evaluation summary report also indicated that different conditions were found during inspections of other mine sites and indicated that some problems with contemporaneous reclamation standards still persist at certain mines.

OSM tracks the ratio of acres of permanent reclamation each year to acres of net disturbance available for reclamation each year. Areas not available for reclamation include things such as stockpiles, active pits, access roads, haul roads, railroad ROWs, coal preparation and loading sites, offices, shops, sediment ponds, and other long-term approved uses. For the 2001 evaluation year, there was a four percent increase in annual acres of reclamation and a 31 percent decrease in annual acres of newly disturbed lands in Wyoming. The ratio of reclamation to net disturbance for the 2001 evaluation year was 1.43. When the ratio is greater than 1.0, the reclamation is greater than the net disturbance. Since 1990, the ratio of reclamation to net disturbance has ranged from a low of 0.40 in 1997 to a high of 1.43 in 2001 (OSM 2002).

Some of the factors that affect achievement of contemporaneous reclamation standards include changing strip ratios which create material surpluses or deficits, using stockpiles to provide material to fill final pit voids or to store new pit boxcut material, changing the direction of mining pits to conform to lease configuration, changing plans to accommodate production growth, and changes in technology or mining method.

Currently, WDEQ/LQD suggests to operators that only large, contiguous areas such as drainage basins be considered for bond release, with the assurance that the area will not be disturbed in the future. Because many mine plans cross a drainage basin several times during the life of mine, final reclamation of some drainage basins may not occur until late in the life of mine.

4.5.1 Topography and Physiography

Following surface coal mining and reclamation, topography will be

modified in an elongated corridor east of and paralleling Highway 59 from just north of Gillette, south for about 75 miles. The topography in the PRB is characterized by relatively flat or rolling topography. After reclamation, these characteristics will be emphasized in the reclaimed area. In general, in the mining corridor, premining features that were more topographically unique (e.g., steeper hills, gullies, and rock outcrops) will be smoothed. As indicated in Section 4.1.1, the premining topography of the LBA tracts is relatively flat to gently rolling, and the expected postmining topography for these tracts is expected to be similar to the premining topography. The carrying capacity for big game may be lower in the mining corridor as a result of the overall reduction in topographic diversity following reclamation. Big game ranges are generally large and extend outside of the mining corridor. Also, mining activities are, in general, not located in habitats defined as crucial; no crucial habitat is included in any of the LBA tracts considered in this EIS. The overall flattening and lowering of the topography would result in increased infiltration of surface water and reduced peak flows from the drainages. These changes would be limited because the streams typically flow from west to east across the area rather than north to south along the entire corridor. Therefore, only a small part of each stream's drainage area would be disturbed (see Section 4.5.5). There would be no substantial cumulative impacts to topography and physiography due to the proximity of CBM development and the proposed railroad line and power plants to the coal mining operations in this area because the construction and operation of those projects would cause minimal topographic and/or physiographic changes.

4.5.2 Geology and Minerals

The PRB coalfield encompasses an area of about 12,000 square miles. Finley and Goolsby (2000) estimate that there are approximately 587 billion tons of coal in beds thicker than 20 ft and deeper than 200 ft in the basin. The remaining strippable Wyodak coal reserves (with 200 ft or less of overburden) are estimated at 15.5 billion short tons (WSGS 2002b). Converse County has a total area of 4,050 square miles of which slightly less than one percent is within current mine permit boundaries. Campbell County has a total area of about 4,760 square miles, of which approximately four percent is within current mine permit boundaries. Coal mining in this area currently disturbs about 3,000 acres annually. Mining and reclamation rates are expected to continue to increase through the year 2015. In the PRB, the coal reserves currently leased represent a small percentage of the total coal reserves but a large percentage of the shallowest (hence the most economical to recover) coal reserves. Within the southern group of five mines, approximately 47,500 acres of federal coal are currently leased. This is about a 75 percent increase over the 27,160 acres of federal coal that were leased in the southern group of mines in 1990, prior to decertification. Under the Proposed Actions, approximately 13,365 additional acres of federal coal would be leased, which would represent a 28 percent increase in the

area of leased federal coal in the southern group of five mines. The area of disturbance associated with mining these leases, which would be greater than the leases themselves, is discussed in other parts of this analysis (e.g., Section 4.5.3).

Coal and CBM are non-renewable resources that form as organic matter decays and undergoes chemical changes over geologic time. The CBM and coal resources that are removed to generate heat and power would not be available for use in the future. No potential damages to the coal resulting from removal of the CBM and water prior to mining have been identified. The CBM operators generally do not completely dewater the coal beds to produce the CBM because that could damage fractures in the coal and limit CBM production. Construction of the proposed railroad line and power plants would not impact the geology or mineral resources in the area, so there would be no overlapping impacts related to these projects.

4.5.3 Soils

The five existing southern mines would disturb approximately 66,582 acres throughout their combined lives (they would disturb approximately 2,000 acres annually during active mining at the currently planned mining rates). The annual disturbance rate would remain at approximately 2,000 acres if the NARO North, NARO South, Little Thunder, West Roundup, and West Antelope LBA Tracts are leased. If all five LBA tracts are leased and mined under the Proposed Actions, the disturbance area in the southern group of mines would increase to approximately 83,957 acres. This would represent an additional 26.1 percent increase in disturbance. Assuming 10 years from initial disturbance to utilization of parcels of reclaimed land by domestic livestock, approximately 20,000 acres (16.2 percent disturbed by Jacobs Ranch Mine, 31.0 percent by North Antelope/Rochelle Complex, 28.5 percent by Black Thunder Mine, 10.0 percent by North Rochelle Mine, and 14.3 percent by Antelope Mine) would be unavailable for such use at any given time during active mining. The replaced topsoil would support a stable and productive native vegetation community adequate in quantity and quality to support planned postmining land uses (i.e., rangeland and wildlife habitat).

Additional, although less extensive, soil disturbance would be associated with the proposed CBM development west of the mines, and with construction of the proposed power plants and railroad line.

4.5.4 Air Quality and Climate

The EPA CALPUFF dispersion model was used with meteorological data generated by the MM5 (mesoscale model) and CALMET models to perform air pollutant dispersion modeling to quantify potential PM_{10} and SO_2 impacts related to proposed oil and gas development, including CBM development, in the PRB in northeastern Wyoming and southeastern Montana. The modeling was conducted to analyze potential air quality impacts from the oil and gas development alternatives being considered in the Wyoming *Final EIS*

and Draft Planning Amendment for the Powder River Basin Oil and Gas Project (BLM 2003) and the Montana *Final Statewide Oil and Gas EIS and Proposed Amendment of the Powder River and Billings RMPs* (BLM in press). These documents will be referred to as the "Wyoming PRB Oil and Gas Project EIS" and the "Montana Statewide EIS," respectively, in the following discussion. The Wyoming Project Area for this air quality analysis includes Campbell, Sheridan, Johnson, and northern Converse Counties. The Montana Project Area for this air quality analysis includes all of Carter, Powder River, Big Horn, Yellowstone, Carbon, Stillwater, Sweetgrass, Wheatland, Golden Valley, Musselshell, and Treasure Counties and portions of Rosebud and Custer Counties. The General Analysis Area for this EIS (the South PRB Coal EIS) is located in southern Campbell and northern Converse Counties, Wyoming, which lies near the southeast corner of the Wyoming Project Area.

Surface coal mining operations in Montana and Wyoming were included in the air quality impact assessment as non-project sources (other reasonably foreseeable emission sources). Coal-related data supplied by the Wyoming and Montana BLM offices for the analysis include estimated coal production volume (based on coal demand forecasts), annual acreage disturbance, and approximate location of mining activity for active mines (based on the currently approved mining and reclamation plan for each mine) in Wyoming and Montana during the years when the overlapping impacts of oil and gas development and other development were estimated to be the greatest.

Construction emissions related to the proposed oil and gas development would occur during potential road and well pad construction, well drilling, and well completion testing. During well completion testing, natural gas may be flared and exhausted. Since the burned natural gas is "sweet" (does not contain sulfur compounds), no objectionable odors are likely to occur.

Maximum potential near-field particulate matter emissions from traffic on unpaved roads and during well pad construction were used to predict the maximum 24-hour and annual average PM_{10} concentrations. Maximum air pollutant emissions from each well would be temporary (i.e., occurring during a short construction period) and would occur in isolation, without significantly interacting with adjacent well locations. During construction, particulate matter emissions from well pad and resource road construction would be minimized by application of water. The control efficiency of the dust suppression was computed at 50 percent during construction. During production and maintenance, the oil and gas operators would not routinely employ dust abatement procedures on roads within the Wyoming PRB Oil and Gas Project EIS Project Area.

This analysis was prepared solely under the requirements of NEPA to assess and disclose reasonably foreseeable impacts to the public and BLM and USFS decision makers. The

air quality impact assessment was based on the best available engineering data and assumptions, meteorology data, and dispersion modeling procedures, as well as professional and scientific judgment. However, where specific data or procedures were not available, reasonable assumptions were incorporated. For example, the air quality impact assessment for Alternative 1 of the Wyoming PRB Oil and Gas Project EIS assumed that all CBM wells would go into production (no dry holes), then operate at full production levels (no shut-ins) for about 7 years, with an overall 20 year LOP. Potential direct project, indirect, and cumulative air quality impacts were analyzed to predict maximum potential near-field ambient air pollutant concentrations and potential HAP impacts, as well as to determine maximum far-field ambient air pollutant concentrations, visibility, and atmospheric deposition (acid rain) impacts. The methodologies used to predict and interpret potential air quality impacts are described in Appendix E.

Air pollution impacts are limited by state, tribal, and federal regulations, standards, and implementation plans established under the CAA and administered by the applicable air quality regulatory agencies (including WDEQ/AQD or the EPA). Although not applicable to the oil and gas development alternatives that were analyzed, the Departments of Environmental Quality for Montana, South Dakota, and Nebraska have similar jurisdiction over potential air pollutant emission sources in their respective states, which can have a cumulative impact with WDEQ/AQD approved sources. Air quality regulations require proposed new, or modified existing air pollutant emission sources (including CBM compression facilities) undergo a permitting review before their construction can begin. Therefore, the applicable air quality regulatory agencies have the primary authority and responsibility to review permit applications and to require emission permits, fees, and control devices, prior to construction and/or operations related to oil and gas development.

The U.S. Congress (through the CAA Section 116) also authorized local, state, and tribal air quality regulatory agencies to establish air pollution control requirements more (but not less) stringent than federal requirements. As discussed in Chapter 1, BLM would not authorize mining by issuing leases for tracts considered in this EIS, but the impacts of mining the coal are considered because it is a logical consequence of issuing a lease. The NARO North, NARO South, Little Thunder, West Roundup, and West Antelope LBA Tracts were applied for by existing mines with air quality permits that have been approved by WDEQ/AQD. If an LBA tract is leased as a maintenance tract to an existing mine, that mine would have to modify its existing approved air quality permit and that modified permit would have to be approved before the LBA tract could be mined. Additional site-specific air quality analysis would be performed, and additional emission control measures (including a BACT analysis and determination) may be required by the applicable air quality regulatory

agencies to ensure protection of air quality.

In cases where BLM does authorize operations, such as approving a permit to drill an oil and gas well, under both FLPMA and the CAA, BLM cannot authorize any activity which does not comply with all applicable local, state, tribal, and federal air quality laws, statues, regulations, standards, and implementation plans. An extensive air quality impact assessment technical support document was prepared to analyze potential impacts from the development alternatives, as well as other reasonably foreseeable emission sources, and is available for review (Argonne 2002).

The significance criteria for potential air quality impacts include state, tribal, and federally enforced legal requirements to ensure air pollutant concentrations will remain within specific allowable levels. These requirements include the NAAQS and WAAQS which set maximum limits for several air pollutants, and PSD increments which limit the incremental increase of certain air pollutants (including NO_2, PM_{10}, and SO_2) above legally defined baseline concentration levels. These legal limits were presented in Table 3-1.

Where legal limits have not been established, BLM uses the best available scientific information to identify thresholds of significant impacts. Thresholds have been identified for HAP exposure, incremental cancer risks, potential atmospheric deposition impacts to sensitive lakes, and a "just noticeable change" in potential visibility impacts.

4.5.4.1 Impacts Common to All Alternatives

The air quality impact analysis used market demand predictions in order to estimate levels of coal production in the PRB for modeling purposes. There is enough coal leased to the existing mines in the PRB to supply this market demand during the time of maximum CBM development activity in the PRB, which is the time when the maximum overlapping impacts to air quality would occur. As a result, the cumulative impacts predicted by the PRB air quality impact assessment would be the same under the Proposed Action and all of the Alternatives for leasing or not leasing federal coal considered in this EIS. Under the No-Action Alternatives (Alternative 1- not leasing the coal included in one or more of the LBA tracts) considered in this EIS, the currently approved mining operations on the existing leases would proceed as permitted. Under the Proposed Actions and Action Alternatives considered in this EIS, the mining operations would move onto the newly leased tracts and the period of time that the mines would be in operation would be extended or the period of maximum anticipated coal production at the existing mines (which are the currently approved rates at those mines) would be extended.

As discussed in Chapter 3, the major air pollutants emitted from surface coal mining activities are fugitive dust and tailpipe emissions from large mining equipment. Activities such as blasting, loading, and hauling of overburden and coal and the large areas of disturbed land all produce

dust. Stationary or point sources are associated with coal crushing, storage, and handling facilities. In general, particulate matter (PM_{10}) is the major significant pollutant from coal mine point sources. The measures that are being used to control air pollutant emissions from existing approved mining operations, which are also described in Chapter 3, include baghouse dust collection systems, PECs, or atomizers/foggers, paving mine access roads, applying water and chemical dust suppressants on all haul roads used by trucks and/or scrapers, limiting haul truck speeds, limiting material drop heights for shovels and draglines (bucket to truck bed or backfill), utilizing permanent and temporary revegetation of disturbed areas to minimize wind erosion, and utilizing stilling sheds at coal truck dumps. In addition, some of the mines are participating in the control of fugitive emissions from some nearby unpaved county roads by applying dust suppressants. These measures would be applied under all of the alternatives being considered in this EIS.

Air quality impacts related to oil and gas development would occur during construction (due to potential surface disturbance by earth-moving equipment, vehicle traffic fugitive dust, well testing, as well as drilling rig and vehicle engine exhaust) and production (including non-CBM well production equipment, booster [field] and pipeline [sales] compression engine exhausts). The amount of air pollutant emissions during construction would be controlled by watering disturbed soils and by air pollutant emission limitations imposed by applicable air quality regulatory agencies. Maximum construction impacts from fugitive dust (24 hour PM_{10}) are estimated to be 55 $\mu g/m^3$, about one third of the applicable WAAQS. Actual air quality impacts depend on the amount, duration, location, and emission characteristics of potential emissions sources, as well as meteorological conditions (wind speed and direction, precipitation, relative humidity, etc.).

The HAP impact analysis was based on a maximum assumed six-unit reciprocating compressor engine station, applicable for all proposed Wyoming PRB Oil and Gas Project EIS Alternatives, as described in Appendix E. Since neither the WDEQ-AQD nor EPA have established HAP standards, predicted 8-hour HAP concentrations were compared to a range of 8-hour state maximum Acceptable Ambient Concentration Levels (EPA 1997a). Formaldehyde was the only HAP predicted to exceed even the lowest threshold level. The maximum predicted cumulative 8-hour formaldehyde impact was 11.9 $\mu g/m^3$, which is within the threshold range of 4.5 $\mu g/m^3$ (Pinnellas County Air Pollution Control Board, Florida) to 71 $\mu g/m^3$ (State of Nevada, Division of Environmental Protection, Air Quality Control). The maximum formaldehyde concentration was predicted to occur at 85 meters (less then 300 ft) adjacent to a compressor station; as the distance from the emission source increases, the predicted concentrations decrease rapidly.

Further analysis was conducted to determine the possible incremental cancer-risk over a 70 year lifetime for

an MLE to residents, and to an MEI, such as compressor station workers. These cancer risks were calculated based on the maximum predicted annual concentrations, EPAs unit risk factors for carcinogenic compounds (EPA 1997b), and an adjustment for time spent at home or on the job. This analysis assumed that residential exposure would be 20 years (well over the national nine year average duration a family lives at a residence) and worker exposure would be 20 years (the full LOP). In addition, it was assumed that family members would be exposed to the maximum formaldehyde concentrations 64 percent of the day, and to one forth of this concentration for the remaining 36 percent of the day.

The resulting incremental cancer risks were calculated to be 1.6×10^{-6} (MLE) and 2.2×10^{-6} (MEI). Both of these values fall near the lower end of the 1 to 100 x 10^{-6} threshold. The MLE and MEI cancer risks would fall below this threshold at 310 and 460 meters away from the emission source, respectively. This distance would be even less for smaller compressor stations.

When reviewing the predicted near- and far-field impacts, it is important to understand that assumptions were made regarding potential resource development, emissions, meteorology, atmospheric transport and chemistry, and atmospheric deposition. For example, there is uncertainty regarding ultimate development (number of wells, equipment to be used, specific locations of wells, etc).

The following assumptions were used in the analysis:

- Total predicted short-term air pollutant impact concentrations were assumed to be the sum of the assumed background concentration, plus the predicted maximum cumulative modeled concentrations, which may occur under different meteorological conditions.

- Assumed background air pollution concentrations were assumed to occur throughout the 20-year LOP at all locations in the region, even though monitoring is primarily conducted in urban or industrial areas, rather than rural areas. The uniform background PM_{10} levels for each state are assumed to be representative of the background conditions for the entire modeled area of the PRB, based on monitoring data gathered throughout northeastern Wyoming and southeastern Montana.

- The maximum predicted air quality impacts occur only in the vicinity of the anticipated emission sources. Actual impacts would likely be less at distances beyond the predicted points of maximum impact.

- All emission sources were assumed to operate at their reasonably foreseeable maximum emission rates simultaneously throughout the LOP. Given the number of sources included in this analysis, the co-probability of such a scenario actually occurring over an entire year (or even 24-hours) is small.

- In developing the emissions inventory and model, there is uncertainty regarding ultimate development (i.e., number of wells, equipment to be used, specific locations, etc.) Most (90 percent) proposed CBM wells and 30 percent of conventional wells were assumed to be fully operational and remain operating (no shut-ins) throughout the LOP.

- The total proposed booster (field) and pipeline (sales) compression engines were assumed to operate at their rated capacities continuously throughout the LOP (no phased increases or reductions). In reality, compression equipment would be added or removed incrementally as required by the well field operation, compressor engines would operate below full horsepower ratings, and it is unlikely all compressor stations would operate at maximum levels simultaneously.

- The HAP analyses assumed a 9,900 horsepower, six-unit, reciprocating compressor engine station would operate at full load and at maximum emission levels continuously throughout the LOP.

- The emissions inventory and model use peak years of construction and peak years of operations, which would not occur throughout the entire development region at the same time. However, it is possible that conditions close to this could occur in some isolated areas.

- The emissions inventory and model assumed a NO_x emission rate for compressor engines of 1.5 g/hp-hr in Montana and 1.0 g/hp-hr in Wyoming. Since BACT is decided on a case-by-case basis, actual emission rates could be decided to be less or more than this level by the Departments of Environmental Quality in Wyoming or Montana, and on Indian lands by EPA, for field and sales compressor engines. Actual NO_x emission rates may range from 0.7 to 2 g/hp-hr.

- There are no applicable local, state, tribal or federal acid deposition standards. In the absence of applicable standards, the acid deposition analysis assumed that a "limit of acceptable change" is: a 10 percent change in ANC for lakes with a background ANC greater than 25 µeq/L; or a 1 µeq/L change in ANC for lakes with a background ANC less than 25 µeq/L, and would be a reasonably foreseeable significant adverse impact. Further, the atmospheric deposition impact analysis assumed no other ecosystem components would affect lake chemistry for a full year (assuming no chemical buffering due to interaction with vegetation or soil materials).

- The visibility impact analysis assumed that a 1.0 dv "just noticeable change" would be a reasonably foreseeable significant adverse impact, although there are no applicable local, state, tribal or federal regulatory visibility standards. However, some FLMs

are using 0.5 dv as a screening threshold for significance.

- Mitigation measures are included in the emissions inventory and model that may not be achievable in all circumstances. However, actual mitigation decided by the developers and local and state authorities may be greater or less than those assumed in the analysis. For example, maintaining a construction road speed limit of 15 mph may be reasonable in a construction zone but difficult to enforce elsewhere. Full (100 percent) mitigation of fugitive dust from disturbed lands may not be achievable. Further, 50 percent reduction in fugitive emissions is assumed based on construction road wetting on the unimproved access road to the pad and at the pad, but this level of effectiveness is characterized as the maximum possible. Wetting was assumed for maintenance traffic, which is not likely to occur, but this is considered to be a small effect because of limited traffic.

- Induced or secondary growth related to increases in VMT (believed to be on the order of 10 percent overall) is not included in the emissions inventory and model. Not all fugitive dust emissions (including county and other collector roads) have been included in the emissions inventory and model.

- Fugitive dust emissions from roads are treated as area sources rather than line sources in the model, which may thereby reduce or increase the predicted ambient concentrations at maximum concentration receptor points near the source, depending on the inputs to the model (meteorology, terrain, etc.). By not placing modeled receptors close to emission sources (e.g., wells and roads), the model may not capture higher ambient concentrations near these sources. A more refined, regulatory model may yield higher concentrations at locations near fugitive dust sources.

- For comparisons to the PSD Class I and II increments, the emissions inventory and model included only CBM and non-project sources. Other existing increment consuming sources such as Campbell County coal mines were not included in this comparison, as the air quality analysis does not represent a regulatory PSD increment consumption analysis. A regulatory PSD increment consumption analysis needs to identify and consider all PSD increment consuming sources to determine the level of PSD Class II increment consumption. Monitoring data in Wyoming has indicated an upward trend in PM_{10} concentrations in Campbell County since 1999, which coincides with CBM development but is also exacerbated by prolonged drought in the region.

Given these assumptions, the predicted impacts represent an estimate of potential air quality impacts.

It is important to note that before actual coal or oil and gas development could occur, the applicable air quality regulatory agencies (including the state, tribe or EPA) would review specific air pollutant emissions pre-construction permit applications that examine source-specific air quality impacts. As part of these permits (depending on source size), the air quality regulatory agencies could require additional air quality impacts analyses or mitigation measures. Thus, before development occurs, additional site-specific air quality analyses would be performed to ensure protection of air quality.

4.5.4.2 Impacts from Temporary Generation

The exact number of temporary natural gas and diesel generators for gas pipeline compressor stations cannot be predicted, but at any one time there may be as many as 400 portable diesel generators and 70 portable gas generators operating. Typical emission factors (in g/hp-hr) for these generators are shown in Table 4-19. Table 4-20 shows the potential ground-level concentrations resulting from operation of these temporary generators.

4.5.4.3 Predicted Air Quality Impacts

The Wyoming PRB Oil and Gas Project EIS evaluates four alternatives. Alternative 1 is the Proposed Action, which assumes that there would be 39,400 new CBM wells in the Wyoming PRB by 2012 in addition to the 12,000 existing wells. The Proposed Action also assumes drilling of an estimated 3,200 conventional oil and gas wells in the same time period. Alternatives 2a and 2b evaluate alternate emission levels and water handling scenarios. Under Alternative 3 (the No Action Alternative), drilling would not occur on federal oil and gas leases but would continue on state and private oil and gas leases. BLM estimates that approximately 15,500 new CBM wells would be developed on state and private lands by 2012 under this alternative, in addition to the 12,000 existing wells. For the purposes of this EIS, the range of potential impacts predicted by the cumulative air quality analysis for all the three oil and gas Action Alternatives are shown in the following tables, as well as the potential impacts predicted under the No Action Alternative. Please refer to the Wyoming PRB Oil and Gas Project Final EIS (BLM 2003)

Table 4-19. Emission Factors for Temporary Generation for Oil and Gas Pipeline Compressors.

Pollutant	**Emission Factor Range (g/hp-hr)**
CO	0.3 to 2.0
NO_x	0.7 to 1.5
$PM_{2.5}$	0.03 to 0.07
SO_2	0.002
VOCs	0.5 to 1.0
Formaldehyde	0.05 to 0.2

Table 4-20. Near-Field Concentrations from a Single Temporary Generator for Oil and Gas Pipeline Compressors.

Pollutant	Averaging Time	Concentration Range ($\mu g/m^3$)	WAAQS ($\mu g/m^3$)
CO	1-hour	55.3 to 403.1	40,000
	8-hour	33.2 to 242.9	10,000
NO_2	Annual	1.9 to 7.5	100
$PM_{2.5}$	24-hour	1.5 to 5.3	65
	Annual	0.1 to 0.4	15
SO_2	3-hour	0.2 to 0.4	1,300
	24-hour	0.09 to 0.3	260
	Annual	0.007 to 0.013	60

to see the individual results for each oil and gas action alternative.

4.5.4.3.1 Wyoming PRB Oil and Gas Project EIS Alternatives 1, 2a, and 2b

Under all three oil and gas Action Alternatives, potential direct project air quality impacts would not violate any local, state, tribal, or federal air quality standards under Alternative 1.

Based on extensive air quality modeling of potential direct project air quality impacts (Argonne 2002), localized short-term increases in CO, NO_x, PM_{10}, and SO_2 concentrations would occur, but all maximum concentrations are expected to be below applicable NAAQS and WAAQS. All maximum near-field direct project NO_2, PM_{10}, and SO_2 concentrations are expected to be below applicable PSD Class II increments (Table 4-21), and all maximum far-field direct project concentrations are expected to be below applicable PSD Class I increments (Appendix E).

Although potential direct project impacts to even the most sensitive far-field lakes would not be significant, a "just noticeable change" in visibility was predicted to occur at from nine to 11 mandatory federal Class I areas, ranging up to five days at the Washakie Wilderness Area. The maximum potential direct project visibility impacts were predicted to occur on from 14 to 20 days per year on the Crow Indian Reservation. A detailed description of the air quality impact analysis is presented in Appendix E.

4.5.4.3.2 Wyoming PRB Oil and Gas Project EIS Alternative 3

Potential direct project air quality impacts would not violate any local, state, tribal, or federal air quality standards under Alternative 3 of the Wyoming PRB Oil and Gas Project EIS, the No-Action Alternative. Based on extensive air quality modeling of potential direct project air quality impacts (Argonne 2002), localized, short-term increases in CO, NO_x, PM_{10}, and SO_2 concentrations would occur, but all maximum concentrations are expected to be below applicable NAAQS and WAAQS.

Table 4-21. Range of Predicted Maximum Potential Near-Field Impacts under Alternatives 1, 2A, and 2B of the Wyoming PRB Oil and Gas Project EIS (with Montana Alternative E).

Pollutant	Averaging Time	Project ($\mu g/m^3$)	Non-Project ($\mu g/m^3$)[2]	Cumulative ($\mu g/m^3$)	PSD Class II ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total ($\mu g/m^3$)	WAAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	6 to 8	3	9 to 10	25	17	26 to 28	100	100
SO_2	Annual	#1	#1	1	20	3	4	60	80
	24-hour	2	2	3	91	8	11	260	365
	3-hour	3	5	5	512	8	13	1,300	1,300
PM_{10}	Annual	3	1	4	17	17	21	50	50
	24-hour	15 to 20	9	25 to 31	30	42	67 to 73	150	150
$PM_{2.5}$	Annual	1 to 2	1	2		8	10	15	15
	24-hour	11 to 16	9	12 to 24		19	38 to 43	65	65
CO	8-hour	77 to 156	124	132 to 156		1,500	1,624 to 1,656	10,000	10,000
	1-hour	157 to 223	142	170 to 224		3,500	3,670 to 3,724	40,000	40,000

[1] The contributions from each source represent maxima and do not necessarily occur at the same location. Therefore, the total concentrations will not always equal the sum of the monitored background, Project, and Non-Project concentrations.

[2] Non-Project sources include CBM sources in Montana and surface coal mining operations in Wyoming and Montana.

All maximum near-field direct project NO_2, PM_{10}, and SO_2 concentrations are expected to be below applicable PSD Class II increments (Table 4-22), and all maximum far-field direct project concentrations are expected to be below applicable PSD Class I increments (Appendix E).

Although potential direct project impacts to even the most sensitive far-field lakes would not be significant, a "just noticeable change" in visibility was predicted to occur one day per year at the mandatory federal Class I Bridger, Fitzpatrick, and Washakie Wilderness Areas. The maximum potential direct project visibility impacts were predicted to occur on 10 days per year on the Crow Indian Reservation. A detailed description of the air quality impact analysis is presented in Appendix E.

4.5.4.4 Cumulative Impacts

Based on a separate assessment predicting potential far-field cumulative air quality impacts (Argonne 2002), the EPA CALMET/CALPUFF dispersion model system was used to predict maximum potential air quality impacts at downwind mandatory federal PSD Class I areas, and other sensitive receptors, to: 1) determine if the WAAQS, NAAQS or PSD Class I increments might be exceeded; 2) calculate potential nitrate and sulfate atmospheric deposition (and their related impacts) in sensitive lakes; and 3) predict potential impacts to visibility (regional haze).

Meteorological information was assembled to characterize atmospheric transport and dispersion from several data sources, including: 1) four kilometer gridded wind field values derived from the MM5 (mesoscale model) with continuous four-dimensional data assimilation; and 2) hourly surface observations (wind speed, wind direction, temperature, cloud cover, ceiling height, surface pressure, relative humidity, and precipitation).

For each Wyoming PRB Oil and Gas Project EIS Alternative, potential air pollutant project sources were combined with non-project sources to determine the total potential cumulative air quality impacts. This included potential cumulative sources from the Montana Statewide EIS sources. The range of potential cumulative impacts correspond to including either the Montana Alternative A (low) or the Montana Alternative B/C/E (high) emission sources. Coal mining operations in Wyoming and Montana were included as non-project sources.

As described above, potential CO and NO_x emissions from reasonably foreseeable booster (field) and pipeline (sales) compressor stations, as well as $PM_{2.5}$, PM_{10}, and SO_2 emissions from construction equipment, were analyzed to predict potential maximum near-field PSD Class II impacts, as well as potential far-field impacts at 29 mandatory federal PSD Class I and other sensitive areas located in Wyoming, Montana, North and South Dakota, and Nebraska (Argonne 2002). Total concentrations are expected to be in compliance with applicable WAAQS and NAAQS (Appendix E). Table 4-23 presents the maximum predicted air pollutant

Table 4-22. Predicted Maximum Potential Near-Field Impacts under Alternative 3 of the Wyoming PRB Oil and Gas Project EIS (with Montana Alternative E).

Pollutant	Average Time	Project ($\mu g/m^3$)[2]	Non-Project ($\mu g/m^3$)[2]	Cumulative ($\mu g/m^3$)	PSD Class II ($\mu g/m^3$)	Background ($\mu g/m^3$)	Total ($\mu g/m^3$)	WAAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	3	3	6	25	17	23	100	100
SO_2	Annual	#1	#1	#1	20	3	3	60	80
	24-hour	1	2	2	91	8	10	260	365
	3-hour	1	5	5	512	8	13	1,300	1,300
PM_{10}	Annual	1	1	2	17	17	19	50	50
	24-hour	7	9	16	30	42	58	150	150
$PM_{2.5}$	Annual	#1	0.7	1		8	9	15	15
	24-hour	6	9	13		19	32	65	65
CO	8-hour	183	124	183		1,500	1,683	10,000	10,000
	1-hour	261	142	261		3,500	3,761	40,000	40,000

[1] The contributions from each source represent maxima and do not necessarily occur at the same location. Therefore, the total concentrations will not always equal the sum of the monitored background, Project, and Non-Project concentrations.

[2] Non-Project sources include CBM sources in Montana and surface coal mines in Wyoming and Montana.

concentrations at specified PSD Class I areas.

Under all four Alternatives (1, 2A, 2B, and 3) considered in the Wyoming PRB Oil and Gas Project EIS, potential non-project and cumulative annual NO_2 concentrations (ranging from 4.1 to 4.2 $\mu g/m^3$) were predicted to be above the PSD Class I increment (2.5 $\mu g/m^3$) within the Northern Cheyenne Reservation. Under all four Wyoming PRB Oil and Gas Project EIS Alternatives, potential project and cumulative 24-hour PM_{10} concentrations (ranging from 10.7 to 12.8 $\mu g/m^3$) were above the PSD Class I increment (8.0 $\mu g/m^3$) within the Northern Cheyenne Reservation. Under Wyoming PRB Oil and Gas Project EIS Alternatives 1, 2A, and 2B, cumulative 24-hour PM_{10} concentrations (ranging from 8.5 to 9.2 $\mu g/m^3$) were also predicted to be above the PSD Class I increment (8.0 $\mu g/m^3$) within the Washakie Wilderness Area. These impacts would be the same under all of the coal leasing alternatives considered in this EIS. As described in Appendix E, other PSD Class I areas had predicted far-field impacts below applicable increments. All PSD Class II areas had predicted far-field impacts below applicable PSD increments. This NEPA analysis compares potential air quality impacts from the proposed Wyoming PRB Oil and Gas Project EIS Alternatives to applicable ambient air quality standards and PSD increments, but comparisons to the PSD Class I and II increments are intended to evaluate a threshold of concern for potential impacts, and do

Table 4-23. Maximum Predicted PSD Class I Area Cumulative Far-Field Impacts (in $\mu g/m^3$) under Wyoming PRB Oil and Gas Project EIS Alternative 1 (Proposed Action) and all South PRB Coal EIS Alternatives.

Pollutant	Averaging Period	Class I Area	Maximum Modeled Concentration (Cumulative)	PSD Class I Increment
NO_2	Annual	Northern Cheyenne Reservation	4.2	2.5
PM_{10}	24-hour	Northern Cheyenne Reservation	12.8	8
	Annual	Northern Cheyenne Reservation	1.7	4
SO_2	3-hour	Northern Cheyenne Reservation	5.1	25
	24-hour	Absaroka-Beartooth Wilderness	2.4	5
	Annual	Northern Cheyenne Reservation	0.3	2

Source: Argonne 2002

not represent a regulatory PSD Increment Consumption Analysis. Even though most of the development activities would occur within areas designated PSD Class II, the potential impacts on regional Class I areas are to be evaluated. For a new source review air quality permit application for a major source, the applicable air quality regulatory agencies may require a regulatory PSD increment analysis. More stringent emission controls beyond BACT may be stipulated in the air quality permits if impacts are predicted to be greater than the PSD Class I or Class II increments.

Several lakes within four USFS designated wilderness areas were identified as being sensitive to atmospheric deposition and for which the most recent and complete data have been collected. The USFS has also identified the following LAC regarding potential changes in lake chemistry: no more than a 10 percent change in ANC for those water bodies where the existing ANC is at or above 25 µeq/L; and no more than a one µeq/L change for those extremely sensitive water bodies where the existing ANC is below 25 µeq/L.

Based on a Rocky Mountain Region USFS screening method (USFS 2000), Table 4-24 demonstrates that potential impacts to most sensitive lakes would be below applicable significance thresholds. However, under all four Wyoming PRB Oil and Gas Project EIS Alternatives (1, 2A, 2B, and 3), potential non-project ANC impacts (1.3 µeq/L) were predicted to exceed the 1.0 µeq/L impact threshold at the very sensitive Upper Frozen Lake within the PSD Class I Bridger Wilderness Area. Cumulative ANC impacts ranged from 1.5 to 1.8 µeq/L. From 13 to nearly 28 percent of these impacts are due to direct contributions from Wyoming PRB Oil and Gas Project EIS Alternatives 1, 2A, 2B, and 3 alone. In addition, under Wyoming PRB Oil and Gas Project EIS Alternative 1, cumulative ANC impacts were predicted to exceed the 10 percent impact threshold (up to 10.4 percent) at Florence Lake within the PSD Class II Cloud Peak Wilderness Area. Nearly 30 percent of these impacts are due to direct contributions from Wyoming PRB Oil and Gas Project EIS Alternative 1. Potential impacts at all other sensitive lakes (and under all Wyoming PRB Oil and Gas Project EIS Alternatives) were below the ANC threshold levels. No sensitive lakes were identified by either the NPS or USFWS.

Since the development of the project and non-project air pollutant emission sources constitute many small sources spread out over a very large area, discrete visible plumes are not likely to affect the mandatory federal PSD Class I areas, but the potential for cumulative visibility impacts (increased regional haze) is a concern. Regional haze degradation is caused by fine particles and gases scattering and absorbing light. Potential changes to regional haze are calculated in terms of a perceptible "just noticeable change" (1.0 dv) in visibility when compared to background conditions.

A 1.0 dv change is considered a small but noticeable change in haziness as described in the Preamble to the EPA Regional Haze Regulations (*Federal Register*, Vol. 64 No. 126, dated July

Table 4-24. Predicted Total Cumulative Change in Acid Neutralizing Capacity at Sensitive Area Lakes (percent change).

Wilderness Area	Lake	Background ANC (µeq/L)	Area (hectares)	Change (percent)	Thresholds (percent)
Bridger	Black Joe	69	890	2.2 to 2.1	10
	Deep	61	205	2.5 to 3.0	10
	Hobbs	68	293	1.3 to1.5	10
	Upper Frozen	5.8[a]	65	1.5 to 1.8[b]	1[b]
Fitzpatrick	Ross	61.4	4,455	1.8 to 2.1	10
Absaroka-Beartooth	Stepping Stone	27	26	2.3 to 2.5	10
	Twin Island	36	45	1.6 to 1.8	10
Cloud Peak	Emerald	553	293	5.0 to 6.0	10
	Florence	32.7	417	8.5 to 10.4	10
Popo Agie	Lower Saddlebag	55.5	155	3.2 to 3.8	10

Notes:
[a] The background concentration is based on only six samples taken on four days between 1997 and 2001.
[b] Since the background ANC value is less than 25 µeq/L, the potential ANC change is expressed in µeq/L, and the applicable threshold is 1.0 µeq/L.
Source: Argonne 2002

1, 1999). A 1.0 dv change is defined as about a 10 percent change in the extinction coefficient (corresponding to a two to five percent change in contrast, for a black target against a uniform sky, at the most optically sensitive distance from an observer), which is a small but noticeable change in haziness under most circumstances when viewing scenes within mandatory federal Class I areas.

It should be noted that a 1.0 dv change is not a "just noticeable change" in all cases for all scenes. Visibility changes less than 1.0 dv are likely to be perceptible in some cases, especially where the scene being viewed is highly sensitive to small amounts of pollution, such as due to preferential forward light scattering. Under other view-specific conditions, such as where the sight path to a scenic feature is less than the maximum visual range, a change greater than 1.0 dv might be required to be a "just noticeable change".

However, this NEPA analysis is not designed to predict specific visibility impacts for specific views in specific mandatory federal Class I areas based on specific project designs, but to characterize reasonably foreseeable visibility conditions that are representative of a fairly broad geographic region, based on reasonable emission source assumptions. This approach is consistent with both the nature of regional haze and the requirements of NEPA. At the time of a pre-construction air quality PSD permit application, the applicable air quality regulatory agency may require a much more detailed visibility impact analysis. Factors such as the magnitude of dv change, frequency, time of the year, and the

meteorological conditions during times when predicted visibility impacts are above the 1.0 dv threshold (as well as the modeling analyses assumptions) should all be considered when assessing the significance of predicted impacts.

The USFS, NPS, and USFWS have published their Final FLAG Phase I Report (*Federal Register*, Vol. 66 No. 2, dated January 3, 2001), providing "a consistent and predictable process for assessing the impacts of new and existing sources on AQRVs" including visibility. For example, the FLAG report states "A cumulative effects analysis of new growth (defined as all PSD increment-consuming sources) on visibility impairment should be performed", and further, "If the visibility impairment from the proposed action, in combination with cumulative new source growth, is less than a change in extinction of 10 percent (1.0 dv) for all time periods, the FLMs will not likely object to the proposed action". Although the FLAG procedures were primarily designed to provide analysis guidance to PSD permit applicants, the following analysis uses the Final FLAG Phase I Report procedures for this NEPA analysis.

Based on multiple iterations of the non-steady state CALPUFF dispersion modeling system, including the CALMET meteorological model, for four different development alternatives, potential cumulative visibility impacts estimated by the seasonal FLAG screening method exceeded the impact thresholds (including the use of FLAG and WDEQ/AQD provided background extinction values) at all 29 sensitive areas analyzed. Therefore, potential maximum visibility impacts were estimated using the daily FLAG refined method (based on hourly optical extinction and relative humidity values measured at two IMPROVE monitoring locations) for each Class I and Class II sensitive area. Although the potential modeled impacts for each sensitive area were based on 1996 MM5 regional meteorology, these values were compared to hourly optical extinction and relative humidity data collected at two locations in the Project Area between 1989 and 1999.

For example, since the 1.0 dv threshold was predicted to be reached within the mandatory federal PSD Class I Washakie Wilderness Area based on the seasonal FLAG screening methodology, the maximum modeled cumulative impacts at that area were also compared to representative hourly optical and relative humidity values measured at Bridger Wilderness Area between 1989 and 1999 using the daily FLAG refined method (Table 4-25). The range of impacts was then summarized as the annual average number of days over the 11-year period predicted to equal or exceed a 1.0 dv "just noticeable change" (Table 4-26).

The prediction of potential visibility impacts based on the daily FLAG refined methodology using measured optical extinction conditions is intended to disclose potential air quality impacts on the affected environment to the public and decision maker before an action is taken. It is not intended to be an air quality regulatory analysis. Such

analysis would be conducted by the applicable air quality regulatory agencies.

It is important to note that before actual development could occur, the applicable air quality regulatory agencies (including the state, tribe or EPA) would review specific air pollutant emissions pre-construction permit applications that examine source-specific air quality impacts. As part of these permits (depending on source size), the air quality regulatory agencies could require additional air quality impacts analyses or mitigation measures. Thus, before development occurs, additional site-specific air quality analyses would be performed to ensure protection of air quality. For further mitigation information see Section 4.3 and Appendix E.

Coal mines develop predictive air quality dispersion models (i.e., FDM, ISCLT3) to assess the potential air quality impacts of their mining operations. Based on these predictive models conducted for PRB mines, mining operations do not have significant off-site particulate pollution impacts, even when production and pollution from neighboring mines are considered. However, this prediction has been based on the assumptions that mining activities are sufficiently removed from the permit boundaries and that neighboring mines are not actively mining in the immediate vicinity (within 0.6 to 2.5 miles). Previous modeling (BLM 1992a) has shown that incremental particulate pollution impacts decrease to insignificant levels (<1 $\mu g/m^3$ PM_{10} annual average) within six miles of active mining.

In cases where mines are in close proximity (within two miles), WDEQ follows a modeling protocol which accounts for all mine-generated particulate air pollutants from all nearby mines to determine impacts to ambient air quality. Known as the Mine A/Mine B modeling procedure, this model evaluates the total impacts of a given mining operation, including those impacts from and on neighboring mines. Under each Proposed Action being evaluated in this EIS, each LBA tract is within two miles of either an existing mine or another LBA tract.

Table 4-25. Predicted Visibility Impacts in the Mandatory Federal PSD Class I Washakie Wilderness Area from Direct Wyoming PRB Oil and Gas Project EIS Alternative Sources - Daily FLAG Refined Method (Average Number of Days per Year Predicted to Equal or Exceed a 1.0 dv "Just Noticeable Change").

Alternative	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1	4	2	7	6	4	7	4	6	7	2	6
2A	2	2	6	5	4	6	4	5	5	1	4
2B	1	2	6	5	3	6	4	4	5	1	3
3	1	0	4	3	1	1	2	2	2	0	0

Note: Potential cumulative visibility impacts were predicted using daily background optical and relative humidity conditions for each of the years listed above.
Source: Argonne 2002

Table 4-26. Predicted Visibility Impacts in Class I Areas - Daily FLAG Refined Method (Average Number of Days per Year Predicted to Equal or Exceed a 1.0 dv "Just Noticeable Change") (Results shown are the predicted impacts under Wyoming PRB Oil and Gas Project Alternatives 1, 1A, 2B, and 3. Impacts related to coal mining under all South PRB Coal EIS Alternatives are included under "Non-Project Sources").

Class I Area	Alt 1	Alt 2A	Alt 2B	Alt 3	Non-Project Sources	Cum Sources
Badlands Wilderness Area[1]	3	3	1	0	13 to 17	18 to 28
Bridger Wilderness Area	4	4	3	1	7 to 9	8 to 12
Fitzpatrick Wilderness Area	4	3	3	1	6 to 9	8 to 12
Gates of the Mtns Wilderness Area	0	0	0	0	3 to 4	3 to 4
Grand Teton National Park	1	1	0	0	3 to 5	4 to 8
North Absaroka Wilderness Area	4	3	2	0	9 to 13	11 to 15
Red Rock Lakes Wilderness Area	0	0	0	0	0 to 1	0 to 3
Scapegoat Wilderness Area	0	0	0	0	2 to 2	2 to 3
Teton Wilderness Area	3	3	2	0	6 to 9	7 to 11
Theodore Roosevelt NMP[2] (North Unit)	0	0	0	0	1 to 1	1 to 3
Theodore Roosevelt NMP[2] (South Unit)	1	0	0	0	1 to 3	2 to 7
U.L. Bend Wilderness Area	1	1	1	0	4 to 5	5 to 8
Washakie Wilderness Area	5	4	4	1	10 to 14	12 to 18
Wind Cave National Park	4	3	2	0	17 to 21	22 to 28
Yellowstone National Park	3	2	1	0	8 to 11	9 to 13
Northern Cheyenne Reservation[3]	17	16	14	7	27 to 82	33 to 92

Notes:

[1] The U.S. Congress designated the Wilderness Area portion of Badlands National Park as a mandatory federal PSD Class I area. The remainder of Badlands National Park is a PSD Class II area.

[2] NMP - National Memorial Park.

[3] Although the Northern Cheyenne Reservation is a tribal designated PSD Class I Area, it is not a mandatory federal PSD Class I area subject to EPA's Regional Haze Regulations.

Non-Project Sources - The impact of all air pollutant emission sources not included in Wyoming PRB Oil and Gas Project EIS Alt 1, Alt 2A, Alt 2B or Alt 3, including existing surface coal mines in Wyoming and Montana and the Montana Statewide EIS sources. The range of potential annual average days above a 1.0 dv "just noticeable change" in visibility corresponds to including Montana Alternative A (low) to Montana Alternative B/C/E (high).

Cum Sources - The impact of all cumulative air pollutant emission sources combined, including Wyoming PRB Oil and Gas Project EIS Alt 1, Alt 2A, Alt 2B, Alt 3, and Non-Project Sources (which include the South PRB Coal EIS Proposed Action and Alternatives and Montana Statewide EIS sources). The range of potential annual average days above a 1.0 dv "just noticeable change" in visibility corresponds to: including Non-Project, Wyoming Alternative 3 and Montana Alternative A sources (low); up to including Non-Project, Wyoming Alternative 1 and Montana Alternative B/C/E sources (high).

Source: Argonne 2002

Gaseous orange clouds, some containing concentrations of NO_x, have been produced by overburden blasting at surface coal mines in the PRB. In 1995, 1998, and 1999, OSM received citizen complaints concerning NO_x gases generated from blasting operations drifting off mine permit areas (OSM 2000). No citizen complaints were received by OSM or WDEQ during the 2001 evaluation year, which ended on September 30, 2001 (OSM 2002). These gaseous orange clouds generally do not overlap due to the distances between mines and the variation in blasting schedules. However, areas adjacent to the permits areas for this group of mines could be affected on different occasions by blasting clouds from several different mines, depending on the weather conditions.

The nature of these blasting clouds and human health consequences resulting from short-term exposures to NO_x are discussed in Section 4.1.4. Included are the results of a study of possible public exposure to NO_2 concentrations from blasting. The evaluation is based on short-term measurements (15 minutes) and the results are compared to NO_2 monitoring results from annual and daily monitoring in the PRB as well as to existing workplace standards for NO_2 exposures. There is no short-term ambient air standard for NO_2 in Wyoming.

In response to the public concern about these clouds and the potential consequences to human health, WDEQ and the mines have developed required and voluntary measures to protect the public from exposure to the clouds. These measures are described in Section 3.5 of this document. The mines in the eastern PRB have also been cooperating in a research and development effort aimed at reducing blasting clouds (Casper Star Tribune, February 3, 2002). This research has led to changes in blasting agents and the size of blasting shots that have reduced NO_x emissions during blasting. As indicated above, no citizen complaints were received by OSM or WDEQ/LQD during the 2001 evaluation year.

Another air quality concern is the venting of methane that occurs when coal is mined. As discussed in Section 3.3 of this document, methane is generated from coal beds. When coal is mined, by surface or underground methods, the methane that is present in the coal is vented to the atmosphere. Methane is a greenhouse gas that contributes to global warming. According to the *Methane Emissions* section of Energy Information Administration/ Department of Energy (EIA/DOE) report 0573(99), *Emissions of Greenhouse Gases in the United States 1999*, U.S. anthropogenic methane emissions totaled 28.8 million metric tons in 1999. U.S. 1999 methane emissions from coal mining were estimated at 2.88 million metric tons (10 percent of the U.S. total anthropogenic methane emissions in 1999). According to Table 15 of this report, surface coal mining was estimated to be responsible for about 0.54 million metric tons of methane emissions in 1999. This represents about 1.88 percent of the estimated U.S. anthropogenic methane emissions in 1999, and about 18.75 percent of the

estimated methane emissions attributed to coal mining of all types.

Table 7.2 of the EIA/DOE *Coal Industry Annual Energy Review for 1999* estimated that 688.3 million short tons of coal were produced by surface mines in the United States in 1999. Surface mines in the Wyoming PRB produced approximately 320 million short tons in 1999, or about 46.5 percent of the total production. Using these numbers, it is estimated that the Wyoming PRB coal mines were responsible for approximately 0.9 percent of the estimated United States 1999 anthropogenic methane emission.

In many areas, including the PRB, CBM is being recovered from coal and sold. On a large scale, recovery of CBM from the coal prior to mining by both surface and underground methods could potentially gradually reduce United States emissions of CBM to the atmosphere. In the PRB, CBM is being produced from the coal areas adjacent to and generally downdip of the mines. CBM is currently being produced from the same coal seams that would be mined in all five of the LBA tracts included in this EIS. As discussed in Section 4.1.2, BLM estimates that a large portion of the CBM reserves could be recovered prior to initiation of mining activity on the LBA tracts under the Proposed Action. CBM reserves that are not recovered prior to mining would be vented to the atmosphere.

4.5.5 Water Resources

Surface Water

Streamflows may be reduced during surface coal mining because SMCRA and Wyoming state regulations require capture and treatment of all runoff from disturbed areas in sedimentation ponds before it is allowed to flow off the mine permit areas. Also, the surface coal mine pits in the PRB are large, and these pits, together with ponds and diversions built to keep water out of the pits, can intercept the runoff from significant drainage areas.

Changes in drainage patterns and surface disturbance are decreasing and will continue to decrease flows in most of the ephemeral and intermittent drainages exiting at the mine sites. Development of CBM resources in the area west of the mines could potentially increase surface flow in some drainages. Currently, there is methane production occurring in the general analysis area. The amount of CBM produced water that ultimately reaches the major channels is reduced by evapotranspiration, infiltration into the ground, and surface landowners, who sometimes divert the produced water into reservoirs for livestock use because it is of relatively good quality. For purposes of analysis, the PRB Oil and Gas Project DEIS (BLM 2002a) assumed that the discharged CBM produced water conveyance losses would be 80 percent due to infiltration and evapotranspiration. A more conservative conveyance loss estimate is being evaluated in the FEIS.

The PRB Oil and Gas Project DEIS estimates that the total number of CBM wells in the Upper Cheyenne River and Antelope Creek drainages, in which the North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mines are located, will be approximately 2,900 wells by 2011. The estimated impacts to Antelope Creek and Upper Cheyenne River flow include increasing the annual average flow at the Antelope Creek gaging station near Teckla by 0.3 to 1.0 cfs and increasing the annual average flow of the Cheyenne River at the Riverview gaging station by 0.2 to 0.3 cfs during 2002 through 2017. Flow impacts would be greater in the Antelope Creek and Cheyenne River tributaries within the LBA tracts, since the tracts are closer to the CBM water discharge locations, and conveyance losses are therefore less than at the downstream gaging stations. These CBM water discharges would be constant, as opposed to naturally occurring flows that fluctuate widely on a seasonal and annual basis. Most streams in the area are naturally dry throughout most of each year.

The U.S. Geological Survey has predicted that, after reclamation, major streams in the PRB will exhibit increased runoff ranging from 0.4 percent in the Cheyenne River to 4.3 percent in Coal Creek due to cumulative disturbance as a result of existing surface coal mining (Martin et al. 1988). This is based on the assumption that unit runoff rates will be increased after reclamation due to soil compaction, and the percentage changes in runoff are based on permitted mine acreages in 1981. The additional leases issued since that time have increased the permitted acreage by about 40 percent and would, under the same assumptions, increase the U.S. Geological Survey's estimated runoff increase by the same incremental amount. This level of increase in runoff is small compared to seasonal and annual variability of runoff in the PRB.

Drainage from all five southern mines combines where Black Thunder Creek enters the Cheyenne River. The drainage area of the Cheyenne River at this point is approximately 2,430 square miles. The entire area of disturbance from these five mines as currently permitted would impact approximately four percent of the drainage basin of the Cheyenne River, and this disturbance would occur over about 50 years. Leasing the five proposed LBA tracts would raise this disturbance acreage to roughly six percent of the Cheyenne River drainage basin at Black Thunder Creek confluence.

Sediment concentrations should not increase significantly in area streams even with the addition of mining the pending and recently issues LBA tracts because, as discussed in Section 4.1.5, state and federal regulations require that all surface runoff from mined lands pass through sedimentation ponds or other sediment control structures. The potential for cumulative adverse impacts to the Cheyenne River drainage is also minimal because it is typically dry for a substantial portion of the year.

The CBM water discharges could result in erosion and degradation of

small drainages, which could affect water quality and channel hydraulic characteristics. From a surface water standpoint, the increased flows due to surface CBM water discharges and the reduced flows due to surface coal mining would tend to offset each other. However, conflicts could also result. The CBM development takes place upstream from the mines. Provisions the mines have taken to prevent water from entering the pits (e.g., storage ponds or diversions) could be adversely affected by flows that were not included in designs or that change conditions for future designs.

Groundwater

As a result of statutory requirements and concerns, several studies and a number of modeling analyses have been conducted to help predict the impacts of surface coal mining on groundwater resources in the Wyoming portion of the PRB. Some of these studies and modeling analyses are discussed below.

In 1987, the U.S. Geological Survey, in cooperation with the WDEQ and OSM, conducted a study of the hydrology of the eastern PRB. The resulting description of the cumulative hydrologic effects of all current and anticipated surface coal mining (as of 1987) was published in 1988 in the U.S. Geological Survey Water-Resources Investigation Report entitled "*Cumulative Potential Hydrologic Impacts of Surface Coal Mining in the Eastern Powder River Structural Basin, Northeastern Wyoming*", also known as the "CHIA" (Martin, et al. 1988). This report evaluates the potential cumulative groundwater impacts of surface coal mining in the area and is incorporated by reference into this EIS. The CHIA analysis included the proposed mining of all the 1987 leases at all of the existing mines in the southern mine group (Jacobs Ranch Mine, Black Thunder Mine, North Rochelle Mine, North Antelope/Rochelle Complex, and Antelope Mine). It did not evaluate potential groundwater impacts related to additional coal leasing in this area and it did not consider the potential for overlapping groundwater impacts from coal mining and CBM development.

Each mine must assess the probable hydrologic consequences of mining as part of the mine permitting process. The WDEQ/LQD must evaluate the cumulative hydrologic impacts associated with each proposed mining operation before approving the mining and reclamation plan for each mine, and they must find that the cumulative hydrologic impacts of all anticipated mining would not cause material damage to the hydrologic balance outside of the permit area for each mine. As a result of these requirements, each existing approved mining permit includes an analysis of the hydrologic impacts of the surface coal mining proposed at that mine. If revisions to mining and reclamation permits are proposed, then the potential cumulative impacts of the revisions must also be evaluated. If one or more of the LBA tracts are leased to the applicants, the existing mining and reclamation permit for each respective mine must be revised and approved to include each new lease before it can be mined.

Additional groundwater impact analyses have also been conducted to evaluate the potential cumulative impacts of coal mining and CBM development. One example of these analyses is the report entitled "A Study of Techniques to Assess Surface and Groundwater Impacts Associated with Coal Bed Methane and Surface Coal Mining, Little Thunder Creek Drainage, Wyoming" (Wyoming Water Resources Center 1997). This study was prepared as part of a cooperative agreement involving WDEQ/LQD, the Wyoming SEO, the WSGS, BLM, OSM, and the University of Wyoming. The Wyodak CBM DEIS (BLM 1999a) and FEIS (BLM 1999c) presented the results of a modeling analysis of the potential cumulative impacts of coal mining and CBM development on groundwater in the coal and overlying aquifers as a result of coal mining and CBM development. The technical report for the Wyodak CBM Project EIS modeling analyses is available for public review at the BLM office in Buffalo, Wyoming (Applied Hydrology Associates, Inc. 1999). The results of these previously prepared analyses are incorporated by reference into this EIS document.

The PRB Oil and Gas Project DEIS (BLM 2002a), which was distributed to the public January 2, 2002, includes an updated modeling analysis of the groundwater impacts if an additional 39,000 new CBM wells are drilled in the PRB by the end of 2011. The project area for this EIS covers all of Campbell, Sheridan, and Johnson Counties, as well as the northern portion of Converse County.

Another source of data on the impacts of surface coal mining on groundwater is the monitoring that is required by WDEQ/LQD and administered by the mining operators. Each mine is required to monitor groundwater levels and quality in the coal and in the shallower aquifers in the area surrounding their operations. Monitoring wells are also required to record water levels and water quality in reclaimed areas.

The coal mine groundwater monitoring data is published each year by GAGMO, a voluntary group formed in 1980. Members of GAGMO include most of the companies with operating or proposed mines in the Wyoming PRB, WDEQ, the Wyoming SEO, BLM, U.S. Geological Survey, and OSM. GAGMO contracts with an independent firm each year to publish the annual monitoring results. In 1991, GAGMO published a report summarizing the water monitoring data collected from 1980 to 1990 in the Wyoming PRB (Hydro-Engineering 1991b). In 1996, they published a report summarizing the data collected from 1980 to 1995 (Hydro-Engineering 1996a). In 2001, GAGMO published a report summarizing the water monitoring data collected from 1980 to 2000 (Hydro-Engineering 2001).

The southern group of mines uses about 1,736 ac-ft of water per year for drinking, sanitation, washing equipment, and dust control. Sources of this water include seepage into the mine pits, sediment- and flood-control impoundments as well as production from the aquifers below the coal. The five southern mines

pump an estimated 1,400 ac-ft per year from the pits and dewatering wells.

The major groundwater issues related to surface coal mining that have been identified are:

- the effect of the removal of the coal aquifer and any overburden aquifers within the mine area and replacement of these aquifers with spoil material;
- the extent of the temporary lowering of static water levels in the aquifers around the mine due to dewatering associated with removal of these aquifers within the mine boundaries;
- the effects of the use of water from the subcoal Fort Union Formation by the mines;
- changes in water quality as a result of mining; and
- potential overlapping drawdown in the coal due to proximity of coal mining and CBM development.

The impacts of large scale surface coal mining on a cumulative basis for each of these issues are discussed in the following paragraphs.

The effects of replacing the coal aquifer and overburden with a spoils aquifer is the first major groundwater concern. The following discussion of recharge, movement, and discharge of water in the backfill aquifer is excerpted from the CHIA (Martin et al. 1988:24):

> Postmining recharge, movement and discharge of groundwater in the Wasatch aquifer and Wyodak coal aquifer will probably not be substantially different from premining conditions. Recharge rates and mechanisms will not change substantially. Hydraulic conductivity of the spoil aquifer will be approximately the same as in the Wyodak coal aquifer allowing groundwater to move from recharge areas where clinker is present east of mine areas through the spoil aquifer to the undisturbed Wasatch aquifer and Wyodak coal aquifer to the west.

Monitoring data from 1990 to 2000 verify that recharge has occurred and is continuing in the backfill (Hydro-Engineering 1991a, 1992, 1993, 1994, 1995, 1996b, 1997, 1998, 1999, 2000, 2001, and ACC 2001). The water monitoring summary reports prepared each year by GAGMO list current water levels in the monitoring wells completed in the backfill and compare them with the 1980 water levels, as estimated from the 1980 coal water-level contour maps. In the 1991 GAGMO 10-year report, some recharge had occurred in 88 percent of the 51 backfill wells reported at that time. In the GAGMO 20-year report, 79 percent of the 82 backfill wells measured contained water.

Coal companies are required by state and federal law to mitigate any water rights that are interrupted, discontinued, or diminished by mining.

The cumulative size of the backfill area in the PRB and the duration of

mining activity would be increased by mining of the recently issued leases and the currently proposed LBA tracts. Since the mined-out areas are being backfilled and the monitoring data demonstrate that recharge of the backfill is occurring, substantial additional impacts are not anticipated as a result of any of the pending leasing actions. Through September 2000 more than 40 percent of the area disturbed at the entire southern group of mines had been backfilled and regraded. Backfill monitoring wells installed to date at four of the five southern mines indicate that recharge is occurring in the backfill.

Clinker or scoria, the baked and fused rock formed by prehistoric burning of the Wyodak-Anderson coal seam, occurs all along the coal outcrop area (Figure 4-14) and is believed to be the major recharge source for the spoil aquifer, just as it is for the coal. However, not all clinker is saturated. Some clinker is mined for road-surfacing material, but saturated clinker is not generally mined since abundant clinker exists above the water table and does not present the mining problems that would result from mining saturated clinker. Therefore, the major recharge source for the spoil aquifer is not being disturbed by current mining. Clinker does not occur on four of the five LBA tracts being considered in this EIS.

The second major groundwater issue is the extent of water level drawdown in the coal and shallower aquifers in the area surrounding the mines. In this EIS, assessment of cumulative impacts to groundwater related to surface coal mining in the southern group of mines is based on impact predictions made by JRCC, ALC, TCC, PRCC, and ACC for mine-related drawdown at the Jacobs Ranch Mine, Black Thunder Mine, North Rochelle Mine, North Antelope/Rochelle Complex, and Antelope Mine, respectively, and extrapolating those drawdowns to consider mining of the five LBA tracts included in this EIS. Figure 4-14 depicts the extrapolated worst-case extent of the five-ft cumulative drawdown contour within the Wyodak coal aquifer resulting from the five southern mine operations, including the five LBA tracts included in this EIS. The extent of the five-ft drawdown contour is used by WDEQ/LQD to assess the cumulative extent of impact to the groundwater system caused by mining operations. In Figure 4-14, these drawdown predictions are compared to the actual monitoring information after 20 years of mining and to modeled predictions in the CHIA. Figure 4-14 shows only the predicted drawdowns in the coal aquifer due to mining. The limited extent of the saturated sand aquifers in the Wasatch Formation overburden in the southern group of mines dictates that drawdowns in the Wasatch Formation are much smaller and cover much less area than the coal drawdowns.

The GAGMO 20-year report provides actual groundwater drawdown information after 20 years of mining. Most of the monitoring wells included in the GAGMO 20-year report (488 wells out of 570 total) are completed in the coal beds in the overlying sediments, or in sand channels or interburden between the coal beds at 16 active and proposed mine sites.

Figure 4-14

Since 1996, some BLM monitor wells have been included in the GAGMO reports. The measured changes in water levels in the coal seams after 20 years of monitoring shown on Figure 4-14, were adapted from the 2001 GAGMO 20-year report (Hydro-Engineering 2001). This map shows the area where actual drawdown in the coal seam was five ft or greater after 20 years of mining. CBM production has significantly affected the extent of drawdown in the General Analysis Area.

Figure 4-14 indicates that the drawdowns observed after 20 years of mining were largely beyond the extent of cumulative drawdown due to all anticipated mining sources predicted in the CHIA. The addition of the pending LBA tracts, including the five LBA tracts included in this EIS, would extend the predicted cumulative extent of the five-ft drawdown caused by coal mining even farther beyond the cumulative drawdown prediction in the 1988 CHIA.

The CHIA predicted the approximate area of five ft or more water level decline in the Wyodak coal aquifer which would result from "all anticipated coal mining". "All anticipated coal mining" at that time included 16 surface coal mines operating at the time the report was prepared and six additional mines proposed at that time. All of the currently producing mines, including the Jacobs Ranch Mine, Black Thunder Mine, North Rochelle Mine, North Antelope/Rochelle Complex, and Antelope Mine were considered in the CHIA analysis (Martin et al. 1988). The study predicted that water supply wells completed in the coal may be affected as far away as eight miles from mine pits, although the effects at that distance were predicted to be minimal.

As drawdowns propagate to the west, available drawdown in the coal aquifer increases. Available drawdown is defined as the elevation difference between the potentiometric surface (elevation to which water will rise in a well bore) and the bottom of the aquifer. Proceeding west, the coal depth increases faster than the potentiometric surface declines, so available drawdown in the coal increases. Since the depth to coal increases, most stock and domestic wells are completed in units above the coal. Consequently, with the exception of methane wells, few wells are completed in the coal in the areas west of the mines. Those wells completed in the coal have considerable available drawdown, so it is unlikely that surface coal mining would cause adverse impacts to wells outside the immediate mine area.

Wells in the Wasatch Formation were predicted to be impacted by drawdown only if they were within 2,000 ft of a mine pit (Martin et al. 1988). Drawdowns occur farther from the mine pits in the coal than in the shallower aquifers because the coal is a confined aquifer that is areally extensive. The area in which the shallower aquifers (Wasatch Formation, alluvium, and clinker) experience a five-ft drawdown would be much smaller than the area of drawdown in the coal because the shallower aquifers are generally discontinuous, of limited areal extent, and often unconfined.

Of the 1,200 water supply wells within the maximum impact area defined in the CHIA study, about 580 are completed in Wasatch aquifers, about 100 in the Wyodak coal aquifer, and about 280 in strata below the coal. There are no completion data available for the remainder of these wells (about 240).

If the five LBA tracts included in this EIS are leased and mined, the groundwater drawdown would be extended into areas surrounding the proposed new leases. The predicted cumulative worst-case drawdown effect from the five southern mines, including the five LBA tracts included in this EIS, is depicted on Figure 4-14. Currently, coal drawdowns from the Jacobs Ranch, Black Thunder and North Rochelle Mines have coalesced, and drawdowns from the North Antelope/Rochelle Complex and Antelope Mine have coalesced. The areas of drawdown from the five southern mines will coalesce in the future with or without the addition of mining activity on the five LBA tracts considered in this EIS.

When a lease is issued to an existing mine for a maintenance tract, the mine must revise its existing mining permit to include the new tract in its mine plan. In order to do that, each lessee would be required to conduct a detailed groundwater analysis to predict the extent of drawdown in the coal and overburden aquifers caused by mining each LBA tract that is leased. WDEQ/LQD would use the revised drawdown predictions to update the CHIA for this portion of the PRB. The applicants have installed monitoring wells which would be used to confirm or refute drawdowns predicted by analysis. This analysis would be required as part of the WDEQ mine permitting procedure discussed in Section 1.2.

Potential water-level decline in the subcoal Fort Union Formation is the third major groundwater issue. According to the Wyoming SEO records as of July 1999, 14 PRB mines held permits for 42 wells between 400 ft and 10,000 ft deep. The zones of completion of these wells were not specified, and not all of the wells were producing (for example, three of the permits were held by an inactive mine, and one of the wells permitted by Black Thunder Mine has not been used since 1984).

Water level declines in the Tullock Aquifer have been documented in the Gillette area. According to Crist (1991), these declines are most likely attributable to pumpage for municipal use by Gillette and for use at subdivisions and trailer parks in and near the city of Gillette. Most of the water-level declines in the subcoal Fort Union wells occur within one mile of the pumped wells (Crist 1991, Martin et al. 1988). The mine facilities in the PRB are separated by a distance of one mile or more, so little interference between mine supply wells would be expected.

In response to concerns voiced by regulatory personnel, several mines have conducted impact studies of the subcoal Fort Union Formation. The OSM commissioned a cumulative impact study of the subcoal Fort Union Formation to address the effects of mine facility wells on this aquifer unit (OSM 1984). Conclusions from all these studies

are similar and may be summarized as follows:

- Because of the discontinuous nature of the sands in this formation and because most large-yield wells are completed in several different sands, it is difficult to correlate completion intervals between wells.

- In the Gillette area, water levels in this aquifer are probably declining because the city of Gillette and several subdivisions are utilizing water from the formation (Crist 1991). (Note: Gillette is mixing this water with water from wells completed in the Madison Formation at this time. Also, because drawdowns have occurred, some operators are able to dispose of CBM water by injecting it into the subcoal Fort Union Formation near the City of Gillette.)

- Because large saturated thicknesses are available (locally) in this aquifer unit, generally 500 ft or more, a drawdown of 100 to 200 ft in the vicinity of a pumped well would not dewater the aquifer.

The four applicant mines adjacent to the five LBA tracts included in this EIS have permits from the Wyoming SEO for eight subcoal Fort Union Formation water supply wells. Extending the life of one or more of the mines with an LBA tract would result in additional water being withdrawn from the subcoal Fort Union Formation (Tullock Member). The additional water withdrawal would not be expected to extend the area of water level drawdown over a substantially larger area due to the discontinuous nature of the sands in the Tullock Member and the fact that drawdown and yield reach equilibrium in a well due to recharge effects. Due to the distances separating subcoal Fort Union Formation wells used for mine water supply, these wells have not experienced interference and are not likely to in the future. The North Antelope/Rochelle Complex wells would be in use for roughly three to 5.5 more years if the NARO North and South LBA Tracts are leased, depending on which alternative is selected. Their annual water production may increase, though not directly in proportion to annual coal production, which could increase by 20 percent if the LBA tracts are leased. The Black Thunder Mine wells would be in use for up to 10.7 years if the Little Thunder LBA Tract is leased, depending on which alternative is selected. Their annual water production may increase, though not directly in proportion to annual coal production, which could increase by 11 percent if the LBA tract is leased. The North Rochelle Mine wells would be in use for roughly 4.5 to 7.1 more years if the West Roundup LBA Tract is leased, depending on which alternative is selected. Their annual water production should not increase, as annual coal production would not increase if the LBA tract is leased. The Antelope Mine well would not be in use for an extended period of time if the West Antelope LBA Tract is leased, regardless of which alternative is selected because mine life would not be extended. The annual water production may increase, though not

directly in proportion to annual coal production, which could increase by 66 percent if the LBA tract is leased.

According to the Wyoming SEO, the only permitted, non-mine water supply wells drilled below 1,000 ft in a 100 square-mile area surrounding Wright are four wells permitted by the City of Wright. As discussed above, most of the water-level declines in the subcoal Fort Union wells occur within one mile of pumped wells. The Black Thunder Mine, which is located about six miles east of Wright, is the closest of the four applicant mines to Wright. None of the mines adjacent to the five LBA tracts propose to drill new sub-coal wells if they acquire additional coal. No impacts to the water supply for the town of Wright are anticipated due to the distance between the mines and the town.

Water requirements and sources for the proposed Two Elk and Two Elk Two power plants near the Black Thunder Mine are not currently known. The Wyoming SEO is discouraging further development of the lower Fort Union Formation aquifers, so the most likely groundwater source for Two Elk power plants is the Lance-Fox Hills. This would reduce the chances that the power plants would add to cumulative hydrologic impacts of mining.

The fourth issue of concern with groundwater is the effect of mining on water quality. Specifically, what effect does mining have on the water quality in the surrounding area, and what are the potential water quality problems in the backfill aquifer following mining?

In a regional study of the cumulative impacts of coal mining, the median concentrations of dissolved solids and sulfates were found to be larger in water from backfill aquifers than in water from either the Wasatch overburden or the coal aquifer (Martin et al. 1988). This is expected because blasting and movement of the overburden materials exposes more surface area to water, increasing dissolution of soluble materials, particularly from the overburden materials that were situated above the saturated zone in the premining environment.

One pore volume of water is the volume of water which would be required to saturate the backfill following reclamation. The time required for one pore volume of water to pass through the backfill aquifer is greater than the time required for the postmining groundwater system to reestablish equilibrium. According to the CHIA, estimates of the time required to reestablish equilibrium range from tens to hundreds of years (Martin et al. 1988).

Chemical analyses of 336 samples collected between 1981 and 1986 from 45 wells completed in backfill aquifers at 10 mines indicated that the quality of water in the backfill will, in general, meet state standards for livestock use when recharge occurs (Martin et al. 1988). The major current use of water from the aquifers being replaced by the backfill (the Wasatch and Wyodak Coal aquifers) is for livestock because these aquifers are typically too high in dissolved solids for domestic use and well yields are typically too low for irrigation (Martin et al. 1988).

According to monitoring data published by GAGMO (Hydro Engineering 1991a, 1991b, 1992, 1993, 1994, 1995, 1996b, 1997, 1998, 1999, and 2000), TDS values in backfill wells have ranged from 400 to 25,000 mg/L. Of the 48 backfill wells sampled in 1999 and reported in the 2000 annual GAGMO report (Hydro-Engineering 2000), TDS in 75 percent were less than 5,000 mg/L, TDS in 23 percent were between 5,000 and 10,000 mg/L, and TDS in one well was above 10,000 mg/L. These data support the conclusion that water from the backfill will generally be acceptable for its current use, which is livestock watering, even before equilibrium is established. The incremental effect on groundwater quality due to leasing and mining of one or more of the five LBA tracts included in this EIS would be to increase the total volume of backfill and, thus, the time for equilibrium to reestablish.

The fifth area of concern is the potential for cumulative impacts to groundwater resources in the coal due to the proximity of coal mining and CBM development. The Wyodak coal is being developed by mining and CBM production in the same general area. Dewatering activities associated with reasonably foreseeable CBM development would be expected to overlap with and expand the area of groundwater drawdown in the coal aquifer in the PRB over what would occur due to either coal mining or CBM development alone.

Numerical groundwater flow modeling was used to predict the drawdown impacts in the Wyodak CBM Project FEIS (BLM 1999c). The modeling considered coal mining and CBM development in order to assess cumulative impacts. Modeling was done to simulate mining with and without CBM development in order to differentiate the impacts of the two types of activities.

Numerical groundwater flow modeling was also used to predict the impacts of the cumulative stresses imposed by mining and CBM development on the Fort Union Formation coal aquifer in the PRB Oil and Gas Project DEIS (BLM 2002a). Modeling was necessary because of the large areal extent, variability, and cumulative stresses imposed by mining and CBM development on the Fort Union coal aquifers. Information from earlier studies was incorporated into the modeling effort for this analysis.

As expected, modeling indicated that the groundwater impacts from CBM development and surface coal mining would be additive in nature and that the addition of CBM development would extend the area experiencing a loss in hydraulic head to the west of the mining area. The 20-year GAGMO report stated that drawdowns in all areas have greatly increased in the last few years due to the water production from the Wyodak coal aquifer by methane producers (Hydro-Engineering 2001).

Figure 4-15 shows the cumulative worst-case coal aquifer drawdown map for the life of the five southern mines (same as Figure 4-14) with the maximum modeled drawdown contours from the PRB Oil and Gas Project DEIS superimposed. These modeled composite maximum coal drawdown contours from mining and

Figure 4-15

CBM development would occur during the period 2006 to 2009 and are for the proposed action of operating 39,367 new CBM wells and 12,077 CBM wells already drilled and permitted for a total of 51,444 CBM wells operating by the end of 2011 (BLM 2002a).

Figure 4-15 indicates that to the north, south and west of the southern mine group, the projected drawdown in the coal aquifer due to CBM production would exceed drawdown due to mining. Drawdowns from CBM development are projected to exceed drawdowns from coal mining as close as one mile from each of the mines.

Drawdowns in the coal caused by CBM development would be expected to reduce the need for dewatering in advance of mining, which would be beneficial for mining. Wells completed in the coal may also experience increased methane emissions in areas of significant aquifer depressurization. There would be a potential for conflicts to occur over who (coal mining or CBM operators) is responsible for replacing or repairing private wells that are adversely affected by the drawdowns; however, the number of potentially affected wells completed in the coal is not large.

As discussed previously, coal companies are required by state and federal law to mitigate any water rights that are interrupted, discontinued, or diminished by coal mining. In response to concerns about the potential impacts of CBM development on water rights, a group of CBM operators and local landowners developed a standard water well monitoring and mitigation agreement that can be used on a case-by-case basis as development proceeds. All CBM operators on federal oil and gas leases are required to offer this water well agreement to the surface landowners (BLM 2002a).

The Wyodak CBM Project FEIS (BLM 1999c) established requirements for federal CBM lessees to install monitoring wells at specific locations throughout the Wyodak EIS study area. According to the PRB Oil and Gas Project DEIS (BLM 2002a), the CBM companies propose to continue this program. The BLM is currently requiring monitoring wells for exploratory CBM development projects outside of the Wyodak EIS study area.

After CBM development and coal mining projects are completed, it will take longer for groundwater levels to recover due to the overlapping drawdown impacts caused by the dewatering and depressuring of the coal aquifer by both operations.

4.5.6 Alluvial Valley Floors

No cumulative impacts to AVFs are expected to occur as a result of leasing and subsequently mining each of the five LBA tracts. Impacts to designated AVFs are generally not permitted if the AVF is determined to be significant to agriculture. AVFs that are not significant to agriculture can be disturbed during mining but they must be restored as part of the reclamation process. Impacts during mining, prior to AVF restoration, would be expected to be incremental, not additive.

4.5.7 Wetlands

Wetlands are discrete features that are delineated on the basis of specific soil, vegetation, and hydrologic characteristics. Wetlands within areas of coal mining disturbance are impacted; wetlands outside the area of disturbance are not directly affected. Therefore, the impacts to wetlands as a result of surface coal mining are incremental, not additive. Increasing the area to be mined would increase the number of wetlands that would be impacted.

The North Antelope/Rochelle Complex has been authorized to impact 272.60 acres of jurisdictional wetlands, Black Thunder Mine 58.29 acres, North Rochelle Mine 20.24 acres, and Antelope Mine 76.67 acres. These numbers would increase if the LBA tracts are leased to these applicants (see Sections 3.8 and 4.1.7 of this document). COE requires replacement of all impacted jurisdictional wetlands in accordance with Section 404 of the Clean Water Act. As part of the mining and reclamation plans for each mine, COE approves the plan to restore wetlands and the number of acres to be restored. Replacement of functional wetlands may occur in accordance with agreements with the surface managing agency (on public land) or by the private landowners. Federal surface lands administered by the USFS are included in the NARO North, Little Thunder, and West Roundup LBA Tracts. During mining and before replacement of wetlands, all wetland functions would be lost. The replaced wetlands may not function in the same way as the premine wetlands did; however, all wetlands would be replaced in accordance with COE requirements.

4.5.8 Vegetation

Most of the land that is being or would be disturbed is grassland, sagebrush shrubland, or breaks grassland and is used for grazing and wildlife habitat. Rangeland is by far the predominant land use in the PRB, accounting for 92 percent of the land use in Converse and Campbell Counties. A small amount of previously cultivated lands would be disrupted by mining. At the completion of mining, it is anticipated that all disturbed land would be reclaimed for grazing and wildlife habitat, mostly in the form of mixed native grass prairie, sagebrush shrubland, and, where appropriate, bottomland grassland. Some of the minor community types, such as those occurring on breaks, would not be restored to premining conditions but may be replaced to a higher level due to use of better quality soils.

Based on annual reports prepared by mining companies and submitted to WDEQ, in any given year approximately 10,000 to 15,000 acres of land disturbed by mining activities at the five existing southern surface coal mines would not be reclaimed to the point of planting with permanent seed mixtures. Over the life of the five southern mines, a total of approximately 66,582 acres would be disturbed. This disturbed area includes all existing leases including federal, state, and private coal. The currently proposed NARO North, NARO South, Little Thunder, West Roundup, and West Antelope LBA Tracts would add another 17,375

acres. Almost all of this acreage is native rangeland and would be returned to a native rangeland state through planting of WDEQ/LQD approved revegetation seed mixtures as required.

Several impacts to vegetation would occur as a result of operations at these five mines. Most of the surface disturbance would occur in two vegetation types: Grassland, and Big Sagebrush. Grassland makes up approximately 33.4 percent of the General Analysis Area and the Big Sagebrush vegetation type makes up approximately 32 percent of the General Analysis Area. All five mines plan to restore these two vegetation types as required by law. It is estimated that it would take from 20 to 100 years for Big Sagebrush density to reach premining levels. The Big Sagebrush component provides important wildlife habitat (particularly for mule deer, pronghorn, and sage grouse). The reduction in acreage of Big Sagebrush vegetation type would, therefore, reduce the carrying capacity of the reclaimed lands for pronghorn and sage grouse populations until premining sagebrush density levels are restored. Mule deer should not be affected since they are not as abundant in this area.

Although some of the less extensive native vegetation types (e.g., Graminoid/Forb Ephemeral Drainages) would be restored during reclamation, the treated grazing lands would not. Following reclamation and release of the reclamation bond, however, privately owned surface lands would be returned to agricultural management and the areas with reestablished native vegetation could again be subject to sagebrush management practices.

Community and species diversities would initially be lower on reclaimed lands. The shrub components would take the longest to be restored to premining conditions. Shrub cover and forage values would gradually increase in the years following reclamation. Over longer periods of time, species re-invasion and shrub establishment on reclaimed lands should largely restore the species and community diversity on these lands to premining levels.

Over the long term, the net effect of the cumulative mine reclamation plans may be the restoration, at least in part, of all vegetation types originally found in the area. However, the shrub component may be substantially reduced in areal extent. Shrubs are relatively unproductive for livestock but very important for wildlife. All of the vegetation types found in the General Analysis Area, as on the LBA tracts, are fairly typical for this region of eastern Wyoming.

4.5.9 Wildlife

The direct impacts of surface coal mining on wildlife occur during mining and are therefore short-term. They include road kills by mine-related traffic, restrictions of wildlife movement created by fences, spoil piles, and pits, and displacement of wildlife from active mining areas. The indirect impacts are longer term and include loss of carrying capacity and microhabitats on reclaimed land due to flatter topography, less diverse

vegetative cover, and reduction in sagebrush density.

After mining and reclamation, alterations in the topography and vegetative cover, particularly the reduction in sagebrush density, would cause a decrease in carrying capacity and diversity on the LBA tracts. Sagebrush would gradually become reestablished on the reclaimed land, but the topographic changes would be permanent.

Cumulative impacts to most wildlife would increase as additional habitat is disturbed but would moderate as more land is reclaimed. Raptor and grouse breeding areas have been diminishing statewide for at least the last 30 years due, in part, to surface disturbing activities. Coal mining and gas exploration and development have been identified as potential contributors to the decline in their breeding habitat. Therefore, surface occupancy and disturbance restrictions, as well as seasonal restriction stipulations, have been applied to operations occurring on or near these crucial areas on public lands. These restrictions have helped protect important raptor and grouse habitat on public lands, but the success of yearlong restrictions on activities near areas critical to grouse has been limited because most of the surface in the PRB is privately owned. Erection of nesting structures and planting of trees on reclaimed land would gradually replace raptor nesting and perching sites. Small- and medium-sized animals would move back into the areas once reclamation is completed.

Numerous grazing management projects (fencing, reservoir developments, spring development, well construction, and vegetative treatments) have also impacted wildlife habitat in the area. The consequences of these developments have proven beneficial to some species and detrimental to others. Fencing has aided in segregation and distribution of livestock grazing, but sheep-tight woven wire fence has restricted pronghorn movement. Water developments are used by wildlife; however, without proper livestock management, many of these areas can become overgrazed. The developed reservoirs provide waterfowl, fish, and amphibian habitat. Vegetation manipulations have included the removal or reduction of native grass-shrublands and replacement with cultivated crops (mainly alfalfa/grass hay), as well as a general reduction of shrubs (mainly sagebrush) in favor of grass. These changes have increased spring and summer habitat for grazing animals, but have also reduced the important shrub component that is critical for winter range, thus reducing overwinter survival for big game and sage grouse. The reduction in sagebrush has been directly blamed for the downward trend in the sage grouse populations.

The regional EIS's (BLM 1974, 1979, 1981, and 1984) predicted significant cumulative impacts to pronghorn from existing concentrated mining and related disturbance as a result of habitat disturbance and creation of barriers to seasonal and daily movements. Significant cumulative indirect impacts were also predicted because of increased human

population and access resulting in more poaching, increased vehicle/pronghorn collisions, and increased disturbance in general. However, the WGFD recently reviewed monitoring data collected on mine sites for big game species and the monitoring requirements for big game species on those mine sites. Their findings concluded that the monitoring had demonstrated the lack of impacts to big game on existing mine sites. No severe mine-caused mortalities have occurred and no long-lasting impacts on big game have been noted on existing mine sites. The WGFD therefore recommended that big game monitoring be discontinued on all existing mine sites. New mines will be required to conduct big game monitoring if located in crucial winter range or in significant migration corridors.

Leasing of the five LBA tracts under the Proposed Actions would increase the area of habitat disturbance in the southern group of mines by 44.3 percent and would enlarge the area where daily wildlife movement is restricted.

The entire NARO North and South, West Roundup, and West Antelope LBA Tracts, and approximately 81 percent of the Little Thunder LBA Tract as proposed are within the Cheyenne River Pronghorn Herd Unit, which includes 4.78 million acres. The mining operations within the Cheyenne River Herd Unit are the North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mines. These mines will cumulatively disturb 48,573 acres within the herd unit based on existing leases. If the five LBA tracts are leased, the estimated mining disturbance within the Cheyenne River Herd Unit would increase by about 16,344 acres to 64,917 acres. This would represent approximately 1.4 percent of the Cheyenne River Herd Unit area.

Approximately 19 percent of the Little Thunder LBA Tract is within the Hilight Pronghorn Herd Unit, which includes approximately 546,000 acres. The mining operations within the Hilight Herd Unit are the Caballo, Belle Ayr, Cordero-Rojo, Coal Creek, Jacobs Ranch, and Black Thunder Mines. These mines will cumulatively disturb 57,512 acres within the herd unit based on existing leases. If the Black Thunder LBA Tract is leased, the estimated mining disturbance within the Hilight Herd Unit would increase by about 1,031 acres to 58,543 acres. This would represent approximately 10.7 percent of the Hilight Herd Unit area.

The five LBA tracts included in this EIS are located within the Thunder Basin Mule Deer Herd Unit. The herd unit contains approximately 2.33 million acres and includes nine permitted coal mines along Highway 59, from Caballo Mine to the north, to Antelope Mine to the south. Currently, permitted disturbance within this nine-mine group includes approximately 106,085 acres. Addition of the five proposed LBA tracts would increase the disturbance area by about 17,375 acres, an increase of 22.4 percent. The 123,460 acres of existing and proposed mine disturbance represents approximately 5.3 percent

of the 2.33 million acre Thunder Basin Mule Deer Herd Unit.

The WGFD big game herd unit maps show the NARO North and South, Little Thunder, and West Roundup LBA Tracts are out of the normal white-tailed deer range. However, white-tailed deer are infrequently recorded in the vicinity of the West Antelope LBA Tract. Incidental observations are generally confined to the Antelope Creek riparian corridor. The WGFD does not consider the five LBA tracts to include elk use areas, but elk have been recorded within the vicinity of the LBA tracts over the past several years and observed wintering on adjacent grasslands in recent years as well. None of the proposed lease areas or areas within two miles has been classified as crucial or critical elk habitat. The nearest crucial elk habitat is just over four miles east of the Little Thunder LBA Tract on the Jacobs Ranch Mine reclaimed mine land. The WGFD (Oedekoven 1994) designated an area of approximately five square miles on Jacobs Ranch Mine reclaimed or adjacent lands as crucial winter habitat for the Rochelle Hills elk herd. There is potential for expansion of elk habitat on the lease areas through quality reclamation.

The area of active mining in the southern group of five mines contains significant numbers of raptor nests. The largest concentration of nesting activity in the area is associated with the rough breaks country and areas where trees have become established. Raptor mitigation plans have been developed and approved in the approved mining and reclamation plans of each mine. The raptor mitigation plan for each mine is subject to USFWS review and approval before the mining and reclamation plan is approved. Any nests that are impacted by mining operations must be relocated in accordance with these plans, after special use permits are secured from USFWS and WGFD. The creation of artificial raptor nest sites and raptor perches may ultimately enhance raptor populations in the mined area. On the other hand, where power poles border roads, perched raptors may continue to be illegally shot and continued road kills of scavenging eagles may occur. Any influx of people into previously undisturbed land may also result in increased disturbance of nesting and fledgling raptors.

Cumulative impacts to waterfowl from already approved mining, as well as the five proposed LBA tracts would be minor because most of these birds are transient and most of the ponds in this area are ephemeral. In addition, the more permanent impoundments and reservoirs that are impacted by mining would be restored. Sedimentation ponds and wetland mitigation sites would provide areas for waterfowl during mining.

Few vital sage grouse wintering areas or leks have been, or are planned to be, disturbed as a result of already approved mining and no additional wintering areas or leks would be disturbed if the LBA tracts included in this EIS are leased and mined. However, noise related to the mining activity could indirectly impact sage grouse reproductive success. Sage grouse leks close to active mining could be abandoned if mining-related

noise elevates the existing ambient noise levels. Surface coal mining activity is known to contribute to a drop in male sage grouse attendance at leks close to active mining, and over time this can alter the distribution of breeding grouse (Remington and Braun 1991). Because sage grouse populations throughout Wyoming have been declining over the past several years, the cumulative impact of all energy related development occurring in the area could be significant to the local sage grouse population.

The addition of the five proposed LBA tracts to the area to be disturbed by currently approved mining operations in the southern PRB would cumulatively increase a reduction in habitat for other mammal and bird species. Many of these species are highly mobile, have access to adjacent habitats, and possess a high reproductive potential. Habitat adjacent to existing and proposed mine areas includes sagebrush shrublands, upland grasslands, bottomland grasslands, improved pastures, haylands, wetlands, riparian areas, greasewood shrublands, and ponderosa pine woodlands. As a result, these species should respond quickly and invade suitable reclaimed lands as reclamation proceeds. A research project on habitat reclamation on mined lands within the PRB for small mammals and birds concluded that the diversity of song birds on reclaimed areas was slightly less than on adjacent undisturbed areas, although their overall numbers were greater (Shelley 1992).

Cumulative impacts on fish habitat and populations would be minimal because local drainages generally have limited value due to intermittent or ephemeral flows. Some of the permanent pools along drainages support minnows and other nongame fish, and the larger impoundments and streams in the area that have fish populations would be restored following mining.

Additional discussions of cumulative impacts to wildlife from coal development and industrialization of the eastern PRB are discussed in BLM regional EISs for the area (BLM 1974, 1979, 1981, and 1984), and these documents are incorporated by reference into this EIS.

The cumulative impacts of mining the five LBA tracts included in this EIS would be assessed during the WDEQ/LQD permit approval process, if they are leased. During the permit approval process, the mine permit applications would be reviewed by WGFD and WDEQ/LQD.

4.5.10 Threatened, Endangered, Proposed, and Candidate Species and USFS Region 2 Sensitive Species

Refer to Appendix G.

4.5.11 Land Use and Recreation

Surface coal mining reduces livestock grazing and wildlife habitat, limits access to public lands that are included in the mining areas, and disrupts oil and gas development. In addition, when oil and gas development facilities are present on coal leases, all associated facilities and equipment must be removed

prior to mining. Mining the coal prior to recovery of all of the CBM resources releases CBM into the atmosphere. The potential impacts of conflicts between CBM and coal development are discussed in Section 4.1.2.

Cumulative impacts resulting from energy extraction in the PRB include a reduction of livestock grazing and subsequent revenues, a reduction in habitat for some species of wildlife (particularly pronghorn, sage grouse, and mule deer), and loss of recreational access to public lands (particularly for hunters).

There are no recreational facilities, wilderness areas, etc., in the immediate vicinity of the existing southern group of mines, and the majority of the land is seldom used by the public except for dispersed recreation (e.g., hunting), off-road vehicles, and sightseeing. Hunting and other public access is generally limited inside of the mine permit areas for safety reasons. However, approximately 77 percent of this land surface is private and access is controlled by the landowner. Leasing the NARO North, Little Thunder, and West Roundup LBA Tracts would affect access to public lands because public lands administered by USFS are included on these tracts. Leasing the NARO South and West Antelope LBA Tracts would not affect access to public lands because no public lands are included on these tracts.

The increased human presence associated with the cumulative energy development in the eastern PRB has likely increased levels of legal and illegal hunting. Conversely, the mines in the area have become refuges for big game animals during hunting seasons since they are often closed to hunting. Reclaimed areas are attractive forage areas for big game. As an example, reclaimed lands at the Jacobs Ranch Mine have been declared crucial elk winter habitat by WGFD (Oedekoven 1994). Energy development-related indirect impacts to wildlife have resulted from and will continue to result from human population growth. Energy development has been the primary cause of human influx into the eastern PRB. Mining the LBA tracts under the Proposed Actions and/or Alternatives 2 and 3 would allow a continuation of employment and production at the North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mines by up to 11 years.

The demand for outdoor recreational activities, including hunting and fishing, has increased proportionately as population has increased. However, at the same time these demands are increasing, wildlife habitat and populations are being reduced. This conflict between decreased habitat availability and increased recreational demand has had (or may have) several impacts: demand for hunting licenses may increase to the point that a lower success in drawing particular licenses will occur; hunting and fishing, in general, may become less enjoyable due to more limited success and overcrowding; poaching may increase; the increase in people and traffic may continue to result in shooting of nongame species and road kills; and increased off-road activities may continue to result in disturbance of

wildlife during sensitive wintering or reproductive periods.

Campbell County's public recreation facilities are some of the most extensively developed in the Rocky Mountain Region, and use by young, recreation-oriented residents is high. The relatively strong financial position of the county recreation program appears to assure future recreation opportunities for residents regardless of the development of the LBA tracts or any other specific mine. Converse County's recreational facilities are not as advanced and development of the LBA tracts and the ensuing employment increase may increase demand for recreational opportunities in Converse County.

4.5.12 Cultural Resources

In most cases, treatment of eligible sites is confined to those that would be directly impacted, while those that may be indirectly impacted receive little or no consideration unless a direct mine-associated effect can be established. The higher population levels associated with coal development coupled with increased access to remote areas can result in increased vandalism both on and off mine property. Surface coal mining operations may contribute to the permanent unintentional destruction of segments of the archeological record. Surface coal mining is generally limited to lands where the overburden thickness is relatively thin (200 ft or less).

A majority of the known cultural resource sites in the eastern PRB are known because of studies at existing and proposed coal mines. Based on the cultural inventories conducted for the five southern mines, there is an estimated average density of 5.7 sites per square mile (640 acres) in this area and approximately 10 percent of these sites are eligible for the NRHP. The cultural inventories conducted on the five LBA tracts found that the density of sites and occurrence of eligible sites is slightly lower than the average density on the NARO North and South, Little Thunder, and West Roundup LBA Tracts, and slightly higher than the average density on the West Antelope LBA Tract. Approximately 580 cultural resource sites will be impacted by already approved mines, with an estimated 86 of these sites being eligible for nomination to the NRHP. These numbers would increase if the LBA tracts are leased.

Adverse impacts to cultural sites include ground disturbance and changes in setting or context. Ground disturbance, the major impact, can affect the integrity of or destroy a site. Changes in setting or context greatly impact historical properties. Mitigation measures such as stabilization, restoration, or moving of buildings may cause adverse impacts to context, in-place values, and overall integrity. Additionally, the loss of a site through mitigation can constitute an adverse impact by eliminating the site from the regional database and/or affecting its future research potential.

Beneficial results or impacts have also occurred from coal development. Valuable data have been collected during cultural resource surveys. Data that would otherwise not be collected until some time in the

future, or lost in the interim, have been made available for study. Mitigation has also resulted in the collection and preservation of data that would otherwise be lost. The data that has been and will be collected provides opportunities for regional and local archeological research projects.

4.5.13 Native American Concerns

No cumulative impacts to Native American traditional values or religious sites have been identified as a result of leasing and subsequent mining of the NARO North and South, Little Thunder, West Roundup, and West Antelope LBA Tracts.

4.5.14 Paleontological Resources

Impacts to paleontological resources as a result of the already approved cumulative energy development occurring in the eastern PRB consist of losses of plant, invertebrate, and vertebrate fossil material for scientific research, public education (interpretive programs), and other values. Losses have and will result from the destruction, disturbance, or removal of fossil materials as a result of surface-disturbing activities, as well as unauthorized collection and vandalism. A beneficial impact of surface mining can be the exposure of fossil materials for scientific examination and collection, which might never occur except as a result of overburden removal, exposure of rock strata, and mineral excavation.

4.5.15 Visual Resources

A principal visual impact within the area of the five southern mines is the visibility of mine pits and facility areas. People most likely to see these facilities would either be passing through the area or visiting it on mine-related business. Except for the loading facilities and the draglines, the pits and facilities are not visible from more than a few miles away. While sufficient capacity exists, future changes in facilities may be constructed to mine the LBA tracts and to improve operating efficiency and air quality protection at the mines.

After mining, the reclaimed slopes might appear somewhat smoother than premining slopes and there would be fewer gullies than at present. Even so, the landscape of the reclaimed mines would look very much like the undisturbed landscape within the General Analysis Area.

4.5.16 Noise

Existing land uses within the eastern PRB (e.g., mining, livestock grazing, oil and gas production, wildlife habitat, and recreation) contribute to noise levels, but wind is generally the primary noise source. Mining on the LBA tracts would not increase the number of noise-producing facilities within the eastern PRB, but it would lengthen the time this particular noise source would exist, expand the area this noise source would affect, and may augment the level of impacts to other resources (e.g., increased exposure of wildlife to noise impact and increased noise impact to recreational users). Mining-related noise is generally masked by the wind at short distances, so cumulative overlap of noise impacts between mines is not likely.

Recreational users and grazing lessees utilizing lands surrounding active mining areas do hear mining-related noise, but this has not been reported to cause a significant impact. As stated above, wildlife in the immediate vicinity of mining may be adversely affected by noise; however, observations at surface coal mines in the area indicate that wildlife generally adapt to noise conditions associated with active coal mining.

Cumulative increases in noise from trains serving the eastern PRB mines have caused substantial increases (more than five dBA) in noise levels along segments of the rail lines over which the coal is transported to markets. However, no significant adverse impacts have been reported as a result.

4.5.17 Transportation Facilities

New or enhanced transportation facilities (road, railroads, and pipelines) are expected to occur as a result of energy development in the PRB. However, no new cumulative impacts to transportation facilities are expected to occur as a direct result of leasing and subsequent mining of the LBA tracts. The transportation facilities for the North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mines are already in place. Construction of new rail facilities for transporting the coal out of the region, such as the proposed DM&E railroad, would add another route of coal transportation out of the basin, but would not be expected to increase the number of coal trains without an increase in market demand for the coal. Traffic levels from the mines would be maintained for a longer time period under the action alternatives. Oil and gas pipelines on the tracts would have to be relocated or removed prior to mining.

4.5.18 Socioeconomics

Because of all of the energy-related development that has been occurring in and around Campbell and Converse Counties in the past 30 years, socioeconomic impacts are a major concern. Wyoming's economy has been structured around the basic industries of extractive minerals, agriculture, tourism, timber, and manufacturing. Each of these basic industries is important. Many Wyoming communities depend on the minerals industry for much of their economic well being. The minerals industry is by far the largest single contributor to the economy of Wyoming. The 2001 valuation on minerals industry production and property in 2000 was $6,407,060,245, or 61 percent of the State's total valuation. Since most minerals are taxed as a percentage of their assessed valuation, this makes the minerals industry a significant revenue base for both local and state government in Wyoming. Wyoming mineral production in 2000 placed the state first in coal production, fifth in natural gas production, sixth in oil production (Wyoming Department of Administration and Information 2002), and sixteenth in nonfuel mineral production in the United States (USGS 2000).

Since 1990, coal production in Campbell and Converse Counties has increased by an average of 7.6

percent per year (Wyoming Department of Commerce 1996 and WSGS 2001c). WSGS is currently projecting that coal production in Campbell and Converse Counties will decrease by 2.1 percent in 2002, increase by 3 percent in 2003, and increase by about one percent per year during 2004 through 2007 (WSGS 2002b). In the first three quarters of 2001, Wyoming coal supplied 39 percent of the nation's steam coal needs, and PRB coal was used to generate electricity for public consumption in 28 states, Canada, Mexico, and Spain (U.S. Department of Energy 2002). Electricity consumers in those states benefit from low prices for PRB coal, from cleaner air due to the low sulfur content of the coal, and from the royalties, taxes, and bonus payments that the federal government receives from the coal.

Locally, continued sale of PRB coal helps stabilize municipal, county, and state economies. By 2005, annual coal production is projected to generate about $2.6 billion of total economic activity, including $351 million of personal income, and support the equivalent of 15,885 full-time positions (BLM 1996a).

In addition to the five proposed LBA tracts studied in this EIS, a number of mineral and related developments have occurred, are in progress, or are anticipated in Campbell County and the surrounding area. The 90-Mw Wygen I coal-fired power plant is currently under construction near the Wyodak Mine east of Gillette. The operator of the facility, Black Hills Energy Capital, Inc., expects the plant to be completed by 2003 (Black Hills Corporation 2001). A second coal-fired plant, the 500-Mw Wygen II, is currently being permitted nearby. NAPG has proposed the construction of three coal-fired power plants in Campbell County: the 300-Mw Two Elk and the 500-Mw Two Elk Two plants near the Black Thunder Mine, and the 500-Mw Middle Bear plant near the Cordero-Rojo Mining Complex (Billings Gazette 2001). In addition, NAPG has proposed the construction of a power line that would link its two 500-Mw power plants with interstate transmission lines in the Front Range of Colorado (Billings Gazette 2002). According to Pedersen Planning Consultants (2001), power plant development between 2001 and 2010 could bring over 6,000 temporary and 450 permanent jobs to Campbell County alone.

The DM&E Railroad Corporation has proposed the construction of a rail line connecting its existing facilities in South Dakota and Minnesota with PRB coal mines. The lead regulatory agency for the expansion project, the Surface Transportation Board, granted final approval in January 2002. DM&E must still obtain permits or approvals from other agencies including the BLM, USFS, and COE, and several lawsuits have been filed against the proposal following the approval of the project by the Surface Transportation Board (WSGS 2002b). For Wyoming, the estimated direct-construction workforce is 700 persons for the estimated $1.5 billion project.

Recently, Gillette has experienced a population increase as a result of CBM development in the area. In the

past several years, Gillette's population has increased, unemployment has decreased, housing has become increasingly tight, and traffic and criminal activity have increased. Under the Proposed Action for the Wyoming Oil and Gas Project DEIS (BLM 2002a), it is assumed that CBM development would require 2,047 employees (1,974 CBM and 67 non-CBM) for a 20-year project life.

If all of the new projects are undertaken, it is likely that the population in northeastern Wyoming would continue to grow, and there would be increasing demands on housing, schools, roads, law enforcement, and other aspects of the communities in this area. The population increase would be expected to be somewhat dispersed among all of the communities in the area, which include Douglas, Wright, and Newcastle as well as Gillette. The extent of the impacts to the local communities would depend on the amount of overlap between the construction periods on the proposed projects. According to a 2001 study of future housing needs in Campbell County (Pederson Planning Consultants 2001), it was estimated that increases in CBM development and surface coal mine employment, coupled with the construction of currently proposed power plants, could increase Campbell County housing demand by over 5,000 housing units, with the peak occurring in about 2005. Delays in power plant and railroad permitting and construction could alter the timing and magnitude of the peak in population and housing demand. At this time, based on the status of their planning and permitting efforts, the Black Hills Corporation, Inc. Wygen I and Wygen II coal-fired power plants, the NAPG Two Elk coal-fired power plant, and the proposed DM&E rail line are considered reasonably foreseeable developments based on the status of their planning and permitting efforts. The NAPG Two Elk Unit Two coal-fired power plant, and the NAPG Middle Bear coal-fired power plant are proposals which are not reasonably foreseeable at this time, and the ENCOAL coal enhancement facility is indefinitely postponed. Of the currently proposed power plants, only the Wygen I plant is currently under construction. Construction of the other proposed plants would be dependent on completion of permitting requirements and availability of financing. Construction of the proposed DM&E railroad is also dependent on completion of permitting requirements and availability of financing as well as resolution of legal issues. Increases in mining employment would potentially occur gradually as new coal leases are permitted for mining. Up to 186 additional jobs are anticipated if all five LBA tracts studied in this EIS are leased.

The construction of coal-fired power plants and the DM&E Railroad expansion and continued CBM development would result in direct fiscal benefits to city, county, and state governments. Equipment and facilities would be subject to excise (sales and use) and ad valorem (property) taxes. Counties that have a major construction project of $50 million or larger also receive extra revenues in the form of impact

assistance. According to an article in the Gillette News-Record, if the three NAPG power plants are constructed, Campbell, Converse, Weston, and Crook Counties could receive as much as $11 million in impact assistance (Gillette News-Record 2001c).

4.6 The Relationship Between Local Short-term Uses of Man*s Environment and the Maintenance and Enhancement of Long-term Productivity

From 2002 on, the North Antelope/Rochelle Complex would be able to produce coal at an average production level of 75 mmtpy for 12 years under Alternative 1 (No Action Alternative), compared with an average of 90 mmtpy for 16 years under the Proposed Action, an average of 90 mmtpy for 17.5 years under Alternative 2, or an average of 90 mmtpy for 15 years under Alternative 3 (Table 2-1). From 2002 on, the Black Thunder Mine would be able to produce coal at an average production level of 38.3 mmtpy for 24 years under Alternative 1 (the No Action Alternative), compared with an average of 42.5 mmtpy for 32 years under the Proposed Action, or an average of 42.5 mmtpy for 34.7 years under Alternatives 2 and 3 (Table 2-2). From 2002 on, the North Rochelle Mine would be able to produce coal at an average production level of 35 mmtpy for 7.3 years under Alternative 1 (No Action Alternative), compared with an average of 35 mmtpy for another 11.8 years under the Proposed Action, or an average of 35 mmtpy for 13.1 years under Alternative 2 (13.4 years under Alternative 2 plus Lease WYW-127221 modification), or an average of 35 mmtpy for another 14 years under Alternative 3 (14.4 years under Alternative 3 plus Lease WYW-127221 modification) (Table 2-3). From 2002 on, the Antelope Mine would be able to produce coal at an average production level of 13.9 mmtpy for another 25 years under Alternative 1 (No Action Alternative), compared with an average of 23 mmtpy for 25 years under the Proposed Action, an average of 24.1 mmtpy for 25 years under Alternative 2, or an average of 20.7 mmtpy for another 25 years under Alternative 3 (Table 2-4).

As the coal is mined, almost all components of the present ecological system, which have developed over a long period of time, would be modified. In partial consequence, the reclaimed land would be topographically lower, and although it would resemble original contours, it would lack some of the original diversity of geometric form.

The forage and associated grazing and wildlife habitat that the LBA tracts provide would be temporarily lost during mining and reclamation. During mining of the LBA tracts there would be a combined loss of native vegetation on 17,375 acres (Proposed Action for all five LBA tracts) up to a maximum of 19,943 acres (Alternative 2 for all tracts except Alternative 3 plus lease WYW-127221 modification for the West Roundup LBA Tract) with an accompanying disturbance of wildlife habitat and grazing land. This disturbance would occur incrementally over a period of years. The mine sites would be returned to

equivalent or better forage production capacity for domestic livestock before the performance bonds are released. Long-term productivity would depend largely on postmining range-management practices, which to a large extent would be controlled by private landowners.

Mining would disturb pronghorn habitat, but the LBA tracts would be suitable for pronghorn following successful reclamation. Despite loss and displacement of wildlife during mining, it is anticipated that reclaimed habitat would support a diversity of wildlife species similar to premining conditions. The diversity of species found in undisturbed rangeland would not be completely restored on the leased lands for an estimated 50 years after the initiation of disturbance. Re-establishment of mature sagebrush habitat--which is crucial for pronghorn and sage grouse--could take even longer.

CBM is currently being recovered from within and/or near each of the LBA tracts and BLM's analysis suggests that a large portion of the CBM resources on each of the tracts can be recovered prior to mining. CBM that is not recovered prior to mining would be vented to the atmosphere during the mining process. Methane is a greenhouse gas which contributes to global warming. According to the *Methane Emissions* section of Energy Information Administration/ Department of Energy (EIA/DOE) report 0573(99), *Emissions of Greenhouse Gases in the United States 1999*, U.S. anthropogenic methane emissions totaled 28.8 million metric tons in 1999. U.S. 1999 methane emissions from coal mining were estimated at 2.88 million metric tons (10 percent of the U.S. total anthropogenic methane emissions in 1999). According to Table 15 of this report, surface coal mining was estimated to be responsible for about 0.54 million metric tons of methane emissions in 1999. This represents about 1.88 percent of the estimated U.S. anthropogenic methane emissions in 1999, and about 18.75 percent of the estimated methane emissions attributed to coal mining of all types. Based on the 1999 coal production figure, the Wyoming PRB coal mines were responsible for approximately 0.9 percent of the estimated U.S. 1999 anthropogenic methane emission, and the North Antelope/Rochelle Complex, Black Thunder, North Rochelle, and Antelope Mines were responsible for approximately 0.4 percent of estimated U.S. 1999 anthropogenic methane emissions. Currently, the North Antelope/Rochelle Complex, Black Thunder Mine, and Antelope Mine anticipate increasing coal production rates if they acquire leases for the NARO North and South LBA Tracts, the Little Thunder LBA Tract, and the West Antelope LBA Tract, respectively. The North Rochelle Mine does not propose to increase coal production rates if they acquire a lease for the West Roundup LBA Tract.

Total U.S. methane emissions attributable to coal mining would not be likely to decrease if one or more of these five LBA tracts are not leased at this time because a decision to lease or not to lease these tracts would not directly affect total U.S. coal

production. However, the methane on an LBA tract could be more completely recovered if leasing is delayed.

If these LBA tracts are leased and mined, there would be a deterioration of the groundwater quality in the lease areas; however, the water quality would still be adequate for livestock and wildlife. This deterioration would probably occur over a long period of time. As a result of mining alone, depth to groundwater would increase within roughly 25 miles away from the five southern mine pits in the coal aquifer. The water levels in the coal aquifer should return to premining levels at some time after mining has ceased because recharge areas would not be disturbed in order to recover the coal in the LBA tracts.

Mining operations and associated activities would degrade the air quality and visual resources of the area on a short-term basis. Following coal removal, removal of surface facilities, and completion of reclamation, there would be no long-term impact on air quality. The long-term impact on visual resources would be negligible.

Short-term impacts to recreation values may occur from reduction in big game populations due to habitat disturbance and reduction in access to some public lands. These changes would primarily impact hunting in the lease areas. However, because reclamation would result in a wildlife habitat similar to that which presently exists and access to public lands would be restored, there should be no long-term adverse impacts on recreation.

The long-term economy of the region would be enhanced as a result of the Proposed Actions and action alternatives. The Proposed Action, Alternative 2, and Alternative 3 would extend the life of the North Antelope/Rochelle Complex by from three to 5.5 years (Table 2-1). The Proposed Action, Alternative 2, and Alternative 3 would extend the life of the Black Thunder Mine by from eight to 10.7 years (Table 2-2). The Proposed Action, Alternative 2, Alternative 2 plus lease WYW-127221 modification, Alternative 3, and Alternative 3 plus lease WYW-127221 modification would extend the life of the North Rochelle Mine by from 4.5 to 7.1 years (Table 2-3). The Proposed Action and Alternatives 2 and 3 are not predicted to extend the life of the Antelope Mine.

4.7 Irreversible and Irretrievable Commitments of Resources

The major commitment of resources would be the mining and consumption of 1,331.2 million tons (Proposed Action for all five LBA tracts) up to a maximum of 1,731.4 million tons (Alternative 2 for all tracts except Alternative 3 plus lease WYW-127221 modification for the West Roundup LBA Tract) of coal to be used for electrical power generation. CBM that is not recovered prior to mining would also be irreversibly and irretrievably lost (see additional discussion of the impacts of venting CBM to the atmosphere in Section 4.6). It is estimated that one to two percent of the energy produced would be

required to mine the coal, and this energy would also be irretrievably lost.

The quality of topsoil on approximately 17,375 acres (Proposed Action for all five LBA tracts) up to a maximum of approximately 19,943 acres (Alternative 2 for all tracts except Alternative 3 plus lease WYW-127221 modification for the West Roundup LBA Tract) would be irreversibly changed. Soil formation processes, although continuing, would be irreversibly altered during mining-related activities. Newly formed soil material would be unlike that in the natural landscape.

Loss of life may conceivably occur due to the mining operations and vehicular and train traffic. On the basis of surface coal mine accident rates in Wyoming as determined by the Mine Safety and Health Administration (1997) for the 10-year period 1987-1996, fatal accidents (excluding contractors) occur at the rate of 0.003 per 200,000 man-hours worked. Disabling (lost-time) injuries occur at the rate of 1.46 per 200,000 man-hours worked. Any injury or loss of life would be an irretrievable commitment of human resources.

Disturbance of all known historic and prehistoric sites on the mine areas would be mitigated to the maximum extent possible. However, accidental destruction of presently unknown archeological or paleontological values would be irreversible and irretrievable.